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Inventory Technology Development

January 1982

SELECTION OF U.S.S.R. FOREIGN SIMILARITY REGIONS

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J. M. Disler

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16. Abstract

The similarity regions in the United States and Canada have been selected to parallel the conditions that affect labeling and classification accuracies in the U.S.S.R. Indicator Regions. In addition to climate, a significant condition that affects labeling and classification accuracies in the U.S.S.R. is the proportions of barley and wheat grown in a given region (based on sown areas). The following regions in the United States and Canada have been determined to be similar to the U.S.S.R. Indicator Regions: (1) Montana Agrophysical Unit (APU) 104 corresponds to the Belorussia High Barley Region; (2) North Dakota and Minnesota APU 20 and secondary region Southern Manitoba and Saskatchewan correspond to the Ural RSFSR Barley and Spring Wheat Region; (3) Montana APU 23 corresponds to the North Caucasus Barley and Winter Wheat Region.

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SELECTION OF U.S.S.R. FOREIGN SIMILARITY REGIONS

Job Order 72-414

This report describes the Experiment Design activities of the Inventory Technology Development project of the AgRISTARS program.

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LOCKHEED ENGINEERING AND MANAGEMENT SERVICES COMPANY, INC.

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For

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PREFACE

The Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing is a multiyear program of research, development, evaluation, and application of aerospace remote sensing for agricultural resources, which began in fiscal year 1980. This program is a cooperative effort of the U.S. Department of Agriculture, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration (U.S. Department of Commerce), the Agency for International Development (U.S. Department of State), and the U.S. Department of the Interior.

The work which is the subject of this document was performed by the Earth Resources Applications Division, Space and Life Sciences Directorate, Lyndon B. Johnson Space Center, National Aeronautics and Space Administration and Lockheed Engineering and Management Services Company, Inc. The tasks performed by Lockheed Engineering and Management Services Company, Inc., were accomplished under Contract NAS 9-15800.

ABBREVIATIONS

AgRISTARS	Agriculture and Resources Inventory Through Aerospace Remote Sensing
APU	Agrophysical Unit
FCPF	Foreign Commodity Production Forecasting
FSR	foreign similarity region
FY	fiscal year
IR	indicator region
ITS	intensive test sites
RSFSR	Russian Soviet Federated Socialist Republic
SSR	Soviet Socialist Republic

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1. INTRODUCTION AND BACKGROUND

Developing and testing inventory technology in the U.S.S.R. is difficult because adequate ground truth is not available. Therefore, techniques need to be developed for similar cold-weather regions in the United States and Canada where ground truth is available. Testing of techniques in the United States and Canada will provide information for future technology adaptation to the U.S.S.R. Indicator Regions (IR's) (ref. 1).

A study has been completed that documents the procedures for selecting FSR's (appendix A). The documented criteria for selecting FSR's in the United States and Canada are that they have climates, crop types, crop distribution, growth cycles, field sizes, and field shapes that are similar to the U.S.S.R. IR's.

The FSR's described in this text are referred to as primary, secondary, and tertiary regions. The primary region is considered the official similarity region. The secondary and tertiary regions are important to the study because they provide more opportunities for matching specific climatic or agronomic characteristics with the U.S.S.R. IR's.

2. SUMMARY

2.1 GENERAL

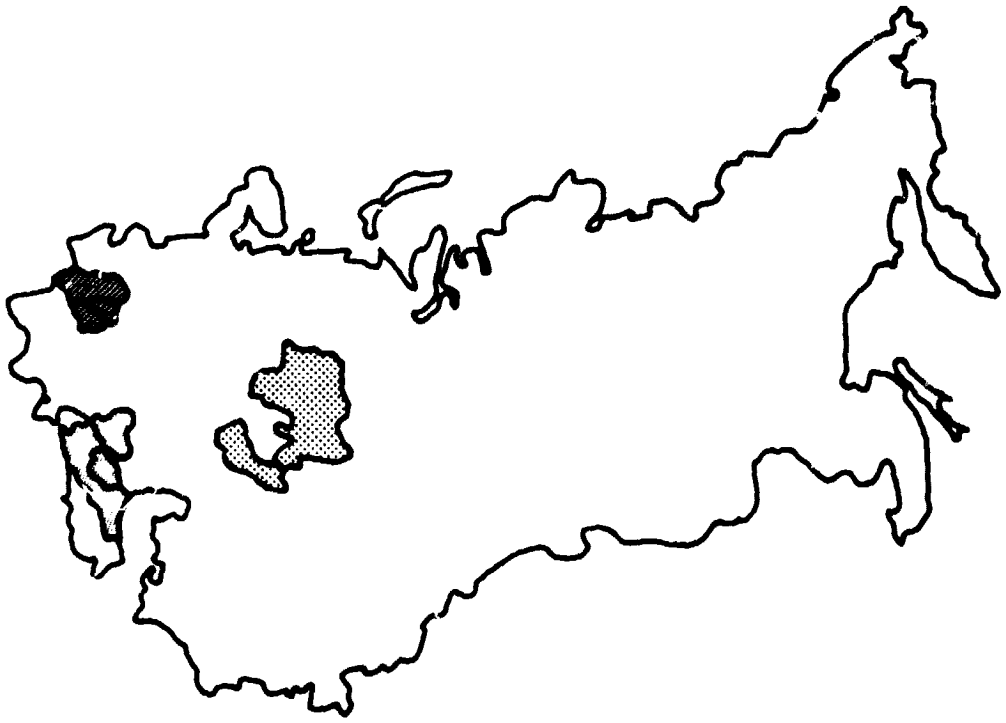
This document provides the selection and comparison of the FSR's with the U.S.S.R. IR's for barley, barley and spring wheat, and barley and winter wheat. The data obtained in this investigation will be used to support the Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing (AgRISTARS) ITD project.

2.2 U.S.S.R. INDICATOR REGIONS

The similarity regions in the United States and Canada were selected to parallel the conditions that affect labeling and classification accuracies in the U.S.S.R. The conditions that affect labeling and classification accuracies in the U.S.S.R. were determined and documented in the U.S.S.R. IR selection task that was completed in September 1980 (ref. 1). In addition to climate, a significant condition that affects accuracies in the U.S.S.R. is the proportions of barley and wheat grown in a given region. Because adequate ground truth is not available in the U.S.S.R., the crop proportions used for the IR selections were the relative percentages of sown areas of wheat, barley, and other crops for the economic regions published in Vestnik Statistiki during harvest years 1976 and 1977 (ref. 1). Recent production and yield data were not available when the U.S.S.R. IR selections were made. The three U.S.S.R. IR's (figure 2-1) that were based on barley and wheat proportions are: (1) Belorussia Soviet Socialist Republic (SSR) High Barley Region; (2) Ural Russian Soviet Federated Socialist Republic (RSFSR) Barley and Spring Wheat Regions; (3) North Caucasus Barley and Winter Wheat Region.

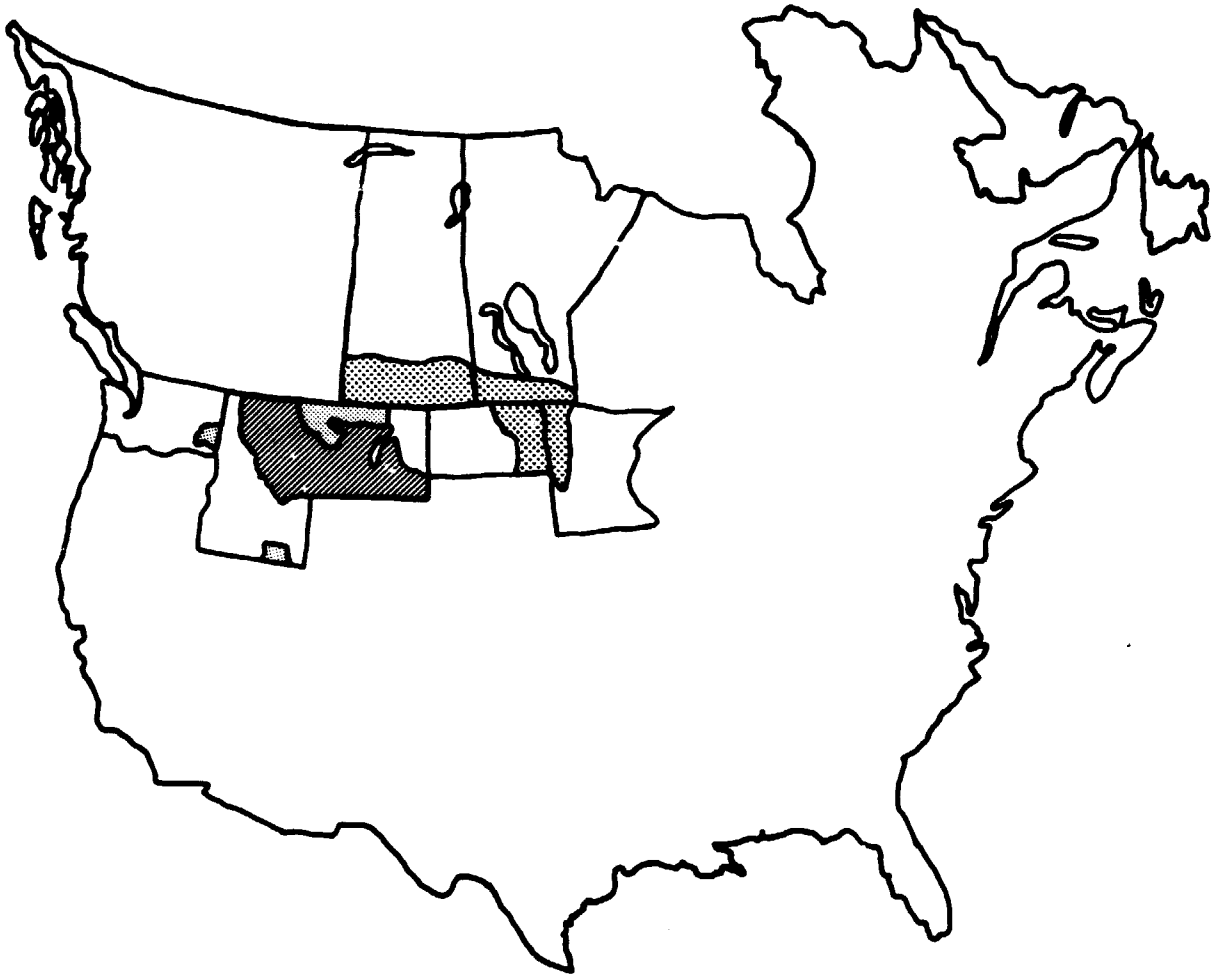
2.3 U.S.S.R. FOREIGN SIMILARITY REGIONS

The following regions in the United States and Canada (fig. 2-2) have been determined to be similar to the regions in the U.S.S.R.: (1) Montana Agrophysical Unit (APU) 104 corresponds to the Belorussia SSR High Barley Region; (2) North Dakota and Minnesota APU 20 and secondary region Southern Manitoba and Saskatchewar correspond to the Ural RSFSR Barley and Spring Wheat Region; (3) Montana APU 23 and secondary and tertiary regions Whitman County,



1. Belorussia SSR High Barley Region
2. Urals RSFSR Barley and Spring Wheat Region
3. North Caucasus RSFSR Barley and Winter Wheat Region

Figure 2-1.- U.S.S.R. Indicator Regions.



1. High barley
   Montana APU 104

2. Barley and spring wheat
   Primary: North Dakota and Minnesota APU 20
   Secondary: Southern Manitoba and Saskatchewan

3. Barley and winter wheat
   Primary: Montana APU 23
   Secondary: Whitman County, Washington
   Tertiary: Bannock, Franklin, and Oneida Counties, Idaho

Figure 2-2.- U.S.S.R. Similarity Regions.

Washington, and Bannock, Franklin, and Oneida Counties, Idaho, correspond to the North Caucasus RSFSR Barley and Winter Wheat Region.

The secondary and tertiary regions are important to the study because they provide more opportunities for matching specific climatic or agronomic characteristics with the U.S.S.R. IR's. The 1977 and 1978 ground truth area proportions at the segment level were used for estimating the crop proportions that were used for selecting FSR's in the United States and Canada.

Tables 2-1, 2-2, and 2-3 provide summary statements for the United States and Canada FSR's and the U.S.S.R. IR's with respect to climate, agronomy, geomorphology, and native vegetation.

TABLE 2-1.- SUMMARY STATEMENTS FOR HIGH BARLEY REGIONS: BELORUSSIA IR AND MONTANA APU 104 FSR

Region	Climate	Agronomy	Geomorphology	Native vegetation
Belorussia	Cool, moist, and cloudy growing season	High barley Crop growth stages vary Average field size: 50 hectares	Fertile, gray, podzol soils Sandhill terrain Elevation: 190 meters	Forest
Montana APU 104	Warm summers, thunderstorms, and low humidity	Crop growth stages vary Average field size: 30 hectares	Black, mollisol soil Hilly and steep terrain Elevation: 1500 meters	Wheat and prairie grasses

TABLE 2-2.- SUMMARY STATEMENTS FOR BARLEY AND SPRING WHEAT REGIONS: URALS IR, NORTH DAKOTA AND MINNESOTA APU 20 FSR (PRIMARY), AND SASKATCHEWAN AND MANITOBA FSR (SECONDARY)

Region	Climate	Agronomy	Geomorphology	Native vegetation
Urals	Cold, dry, continental climate	Crop proportions and growth stages similar to APU 20 and Saskatchewan and Manitoba Average field size: 300 hectares	Brown, sedimentary soil Elevation: 300 meters	Grass and patches of wood steppe
North Dakota and Minnesota APU 20	Cold, dry, continental climate	Average field size: 24 hectares	Black, glacial soil Elevation: 300 meters	Bluestem grass
Saskatchewan and Manitoba	Cold, dry, continental climate	Average field size: 100 hectares	Black, glacial soil Elevation: 600 meters	Grass

TABLE 2-3.- SUMMARY STATEMENTS FOR BARLEY AND WINTER WHEAT REGIONS: NORTH CAUCASUS IR, MONTANA AFU 23 FSR (PRIMARY), WHITMAN COUNTY, WASHINGTON FSR (SECONDARY), AND IDAHO FSR (TERTIARY)

Region	Climate	Agronomy	Geomorphology	Native Vegetation
North Caucasus	Semiarid, cold, continental climate	Crop proportions and growth stages similar to APU 23, but has more barley than APU 23 Fields are much larger than APU 23	Chestnut brown and black soil; uplifted sedimentary origin; rolling terrain Elevation: 457 meters	Virgin steppe
Montana APU 23	Semiarid, cold, continental climate; drier than North Caucasus	Crop proportions and growth stages are similar to North Caucasus	Gray and brown loams; glacial origin Elevation: 900 meters	Gramma, needle, and wheat grasses
Whitman County, Washington	Semiarid, cold, continental climate	Crop proportions and field sizes similar to North Caucasus, but differences in growth stages	Brown and black soils; rolling terrain Elevation: 400-500 meters	Wheat, blue, and cheat grasses and shrubs
Idaho	Cold, continental climate, but not as humid as North Caucasus	Crop proportions and field sizes similar to North Caucasus, but differences in growth stages; fields are smaller than North Caucasus	Brown, mollisol soils; terrain of lava origin Elevation: 1372 meters	Grasses and brush

3. U.S.S.R. SIMILARITY REGIONS

The selected U.S.S.R. Similarity Regions will now be examined. Tables are included that list the ground truth segments within each similarity region, and, where available, the average proportions of small grains are also given.

3.1 HIGH BARLEY REGION

A high barley region is considered to be a geographic area where barley is grown in a quantity larger than other spring small grains, particularly spring wheat. A true high barley similarity region for the Belorussia SSR High Barley Region probably does not exist. Barley is not grown in the United States and Canada in quantities sufficient enough to be labeled high barley regions. In most areas where barley grows in relatively high quantities, the climate is not similar to the Belorussia SSR High Barley Region.

Another problem is the availability of ground truth. Historical crop statistics may indicate a given area grows a relatively high quantity of barley, but the randomly placed ground truth sites usually do not contain a significant number of barley fields. (A literature search indicated that barley was grown in the largest concentrations in the following states: Montana, North Dakota, Minnesota, South Dakota, Oklahoma, Colorado, Nebraska, Kansas, and Texas.)

The LACIE Phase III ground truth (blind) sites were screened in order to identify the segment numbers for those sites that have a high barley yield relative to other spring small grains. Table 3-1 provides the segment numbers by states for these barley sites, and it shows that the ground truth sites in Montana contain more barley than the other listed states. Because of its climatic and other agronomic variables, Montana APU 104 was chosen as the best - though not optimum - similarity region for comparison with the Belorussia SSR High Barley Region.

TABLE 3-1.- PHASE III BLIND SITES CONTAINING BARLEY FIELDS

State	Segments	Average percent barley
Montana	1102, 1104, 1529, 1537 1725, 1730, 1734, 1739 1742, 1747, 1750, 1752 1753, 1937, 1948	7.5
South Dakota	1489, 1498, 1669, 1675 1677, 1681, 1694, 1699 1811	2.0
Colorado	1000, 1008, 1501, 1502 1506	1.5
Nebraska	1564, 1571	.4
Kansas	1175, 1180, 1183, 1340	.6
Oklahoma	1222, 1223, 1236, 1239, 1367	.8
Texas	1056, 1086	2.1

North Dakota and Minnesota are not included because of their high proportions of other spring small grains.

3.1.1 MONTANA AGROPHYSICAL UNIT 104

Although the climatic and agronomic similarities between Montana APU 104 and the Belorussia Region are less than optimum, their cold winters with mild periods are approximately equivalent (table 3-2, refs. 2 and 3). However, there is a considerable climatic difference between the two during the summer months.

Montana is described in the Modified Kophen Climatic Classification System as semiarid with abundant spring precipitation, warm summers, low humidity, occasional thunderstorms, and light precipitation in the fall. The Belorussia Region has cool, moist, and cloudy summers with almost twice the average precipitation as APU 104.

The variability in climate between the two regions is reflected in the nominal growth stages for small grains as shown in figures 3-1 and 3-2. Barley is planted earlier in the Belorussia Region, but it enters the jointing stage later than the barley in APU 104. By the first week of July, barley is 50 percent headed in both the Belorussia Region and APU 104, but in the Belorussia Region the barley enters the turning stage and is harvested a week to two weeks earlier than in APU 104.

Winter wheat in APU 104 and winter rye in the Belorussia Region are both second in abundance to barley in their regions. Spring wheat and oats grow in relatively small proportions in both regions. The average field sizes are smaller in APU 104 (30 hectares) than they are in the Belorussia Region (approximately 50 hectares).

The available ground truth for APU 104 is not extensive, but it should be adequate for the initial experiment design and testing phases of AgRISTARS. Table 3-3 provides the blind site segments within APU 104, noting the years for which ground truth is available and the available acquisition histories. No intensive test sites (ITS) fall within APU 104.

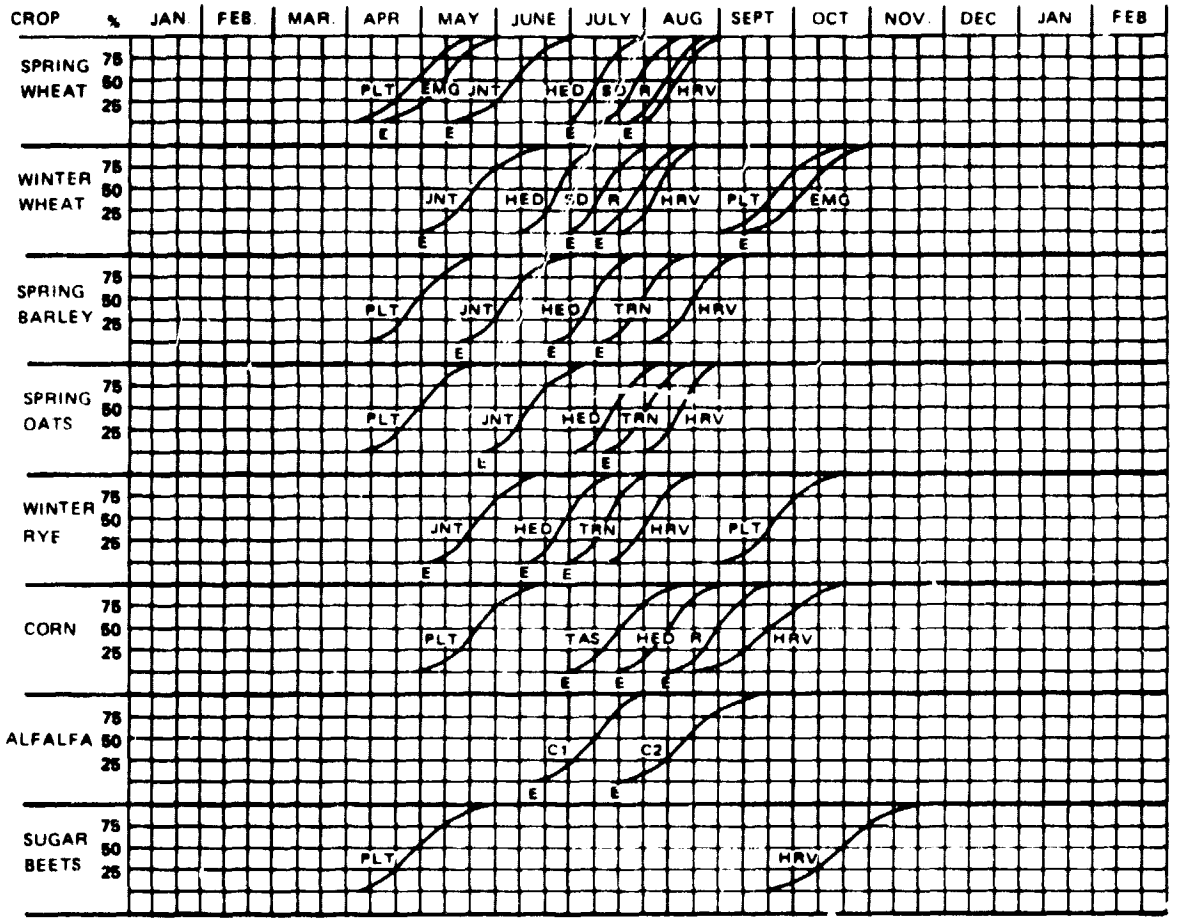
TABLE 3-2.- MONTANA APU 104 COMPARED TO BELORUSSIA HIGH BARLEY REGION

	Montana APU 104	Belorussia Region
Climate	Semiarid Cold winters with mild periods Warm summers Good spring precipitation Light precipitation in fall Least precipitation November through February Thunderstorms in summer, low humidity Average January temperature: -8.1° C Average July temperature: 21° C Average annual precipitation: 335.3 mm Mean spring frost dates: May 15-30 Mean autumn frost dates: September 15-30	Snow cover thin to moderate during winter because of rapid thawing Cool, moist and cloudy summers Snow cover 70-100 days Winter kill infrequent Mean maximum temperature May through September: +20° C Average annual precipitation: 508-660 mm Spring frost dates: early May Autumn frost dates: early October Average January temperature: -6° C Average July temperature: 19° C
Agronomy	Major small grains percent: 1969 1973 Barley: 26% 33% Winter wheat: 21% 18% Spring wheat: 4% 3% Oats: 4% 3% Hay: 52% 50% (Percentage of cropland harvested) Other crops present: Corn, potatoes Average field size: 30 hectares Valleys may be irrigated Most wheat grown on dry land Strip fallow common Winter wheat, barley, summer fallow or spring wheat fallow rotation Stubble mulching combined with summer fallowing Tillage in spring direct combining Swathing done if weedy	Major small grains percent: Barley: 20.1% Winter wheat: 2.2% Spring wheat: 0.2% Oats: 5.5% Rye: 14.2% (Percentage of sown crops in 1977) Other crops present: sugar beets, potatoes, flax Average field size: 40-61 hectares (estimated from imagery) Belorussia not in major area of wheat production Spring barley and winter rye are major grains with emphasis on flax, potatoes, and livestock Winter wheat rotated with fallow, grasses Both direct combining and swath harvesting Moist summers do not provide optimum conditions for ripening wheat
Geomorphology and geology	Dissected plain underlain by shale and sandstone Slopes are rolling to steep; western part of stratum is mountainous and glacial till to the east Elevations: 700 to 3000 meters	Glacial influence: moraines, peat bogs, marshes, glacial plains, and sand hills Elevation: 190 meters
Soils	Black (borolls and mollisols)	Podzol, sandy
Native vegetation	Wheat grass, foothill prairie grass	Forest

TABLE 3-3.- AVAILABLE ACQUISITIONS FOR MONTANA APU 104 BLIND SITES

Segment	CRD	County	Ground truth						Acquisition
			Phase I (1975)	Phase II (1976)	Phase III (1977)	TY (1978)	1979	1980	
1102	80	Yellowstone			X				6038, 6260, 6261, 6278, 6314 6350, 7039, 7056, 7074, 7075, 7111, 7129, 7146, 7147, 7165, 7182, 7200
1104	90	Rosebud			X				6214, 6259, 6260, 6349, 6350, 7074, 7109, 7127, 7128, 7146, 7164, 7181, 7182, 7199, 7200, 7236,
1389	90	Powder River				X			7252, 7253, 7270, 7306, 8085, 8086, 8103, 8122, 8140, 8194, 8203, 8211, 8247, 8266
1549	80	Big Horn		X	X				4315, 5306, 6134, 6188, 6206, 6224, 6260, 7146, 7182, 7200
1552	80	Yellowstone	X						4280, 5158, 6225, 6261, 7039, 7129, 7165, 7219, 7237
(1553)[1]	90	Carter	X			X			6312, 7103, 7180, 7198, 7252, 7270, 7288, 7306, 8104, 8122, 8140, 8193, 8194, 8203, 8211, 8220, 8247, 8266
1556	90	Powder River			X				5210, 5228, 5318, 6187, 6205, 6222, 6240, 6259, 6312, 7127, 7162, 7180, 7235
1592	80	Big Horn							7254, 7290, 7308, 8141, 8195, 8213, 8222, 8231, 8249, 8258
1725*	10	Flathead		X	X	X	X		5162, 5180, 5216, 5217, 5252, 5253, 6121, 6122, 6139, 6140, 6157, 6230, 6247, 6248, 6265, 6302, 7098, 7152, 7170, 7188, 7223, 7224, 7277, 7278, 8002, 8165, 8182, 8183, 8201, 8209, 8210, 8218, 8219, 8263, 9142, 9178, 9196, 9204. 9213, 9214, 9241, 9250
(1742)[1]	50	Cascade		X	X	X			5142, 5178, 5304, 6101, 6137, 6191, 6209, 6245, 6263, 6281, 6299, 7113, 7167, 7203, 7257, 7293, 7311, 8207, 8216, 8282
(1747)[1]	50	Judith Basin		X	X				5196, 5250, 5304, 6155, 6208, 6200, 6244, 6245, 6316, 7022, 7112, 7130, 7184
1749	70	Beaverhead		X					5161, 5162, 5180, 5215, 5216, 5251, 6138, 6139, 6156, 6547, 6192, 6193, 6210, 6211, 6246, 6247
1750*	70	Gallatin			X				5195, 6191, 6209, 6281, 6298, 6316, 7203, 7221
1752	80	Park			X				5304, 6101, 6137, 6155, 6173, 6191, 6208, 6226, 6244, 6245, 6280, 6298, 6316, 7112, 7130, 7184, 7203, 7256, 8144, 8179, 8180, 8206, 8207, 8215, 8224, 8233, 8242, 8252, 8269
1753	80	Stillwater			X				6154, 6190, 6208, 6225, 6226, 6244, 6352, 7039, 7075, 7088, 7129, 7255, 7256, 8160, 8178, 8215, 8223, 8232, 8233, 8251. 8268
(1937)[1]	20	Pondera			X				6263, 6264, 6281, 6282, 6299, 6300, 6317, 6318, 6354, 7023, 7050, 7096, 7113, 7114, 7132, 7168, 7203
1945	30	Valley			X	X			6260, 6296, 7182, 8015, 8141, 8142, 8159, 8160, 8178, 8195, 8196, 8223, 8232, 8250, 8258

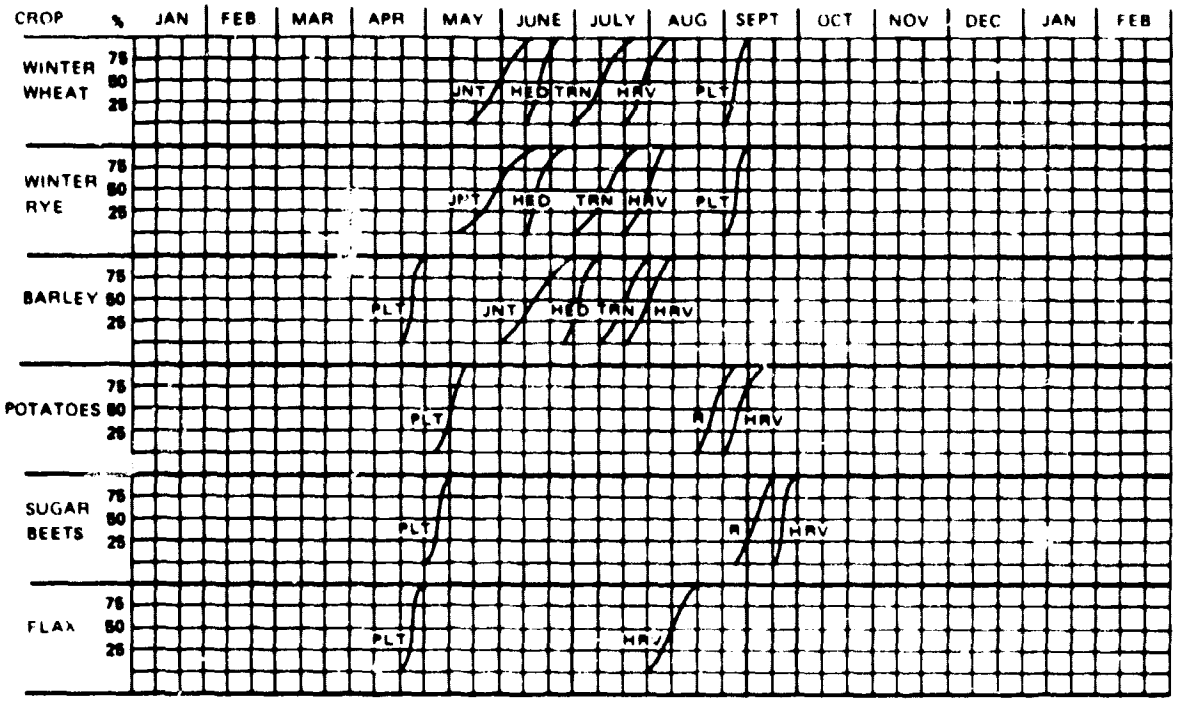
[1]Segment numbers in parentheses are near APU 104 boundaries and may or may not be actually located within APU 104.
*Highest barley segments.



LEGEND

E	Under stage name, indicates rough estimate of date
EMG	Emergence
HED	Heading
HRV	Harvest
JNT	Jointing
PLT	Planting
R	Ripe
SD	Soft dough
TRN	Turning
C	Cut
TAS	Tasseling

Figure 3-1.- Nominal crop calendar for Montana APU 104.



LEGEND

E	Under stage name, indicates rough estimate of date
EMG	Emergence
HED	Heading
HRV	Harvest
JNT	Jointing
PLT	Planting
R	Ripe
SD	Soft dough
TRN	Turning

Figure 3-2.- Nominal crop calendar for Belorussia SSR High Barley Region.

The proportions estimates derived from six LACIE Phase III blind sites in APU 104 for barley, wheat, and oats are given in table 3-4. Note the high proportion of barley compared to the other small grains. The transition year proportions for specific crop types had not been summarized at the time this study was conducted.

3.2 BARLEY AND SPRING WHEAT REGION

3.2.1 NORTH DAKOTA AND MINNESOTA AGROPHYSICAL UNIT 20

North Dakota and Minnesota APU 20 was selected for comparison with the Ural Barley and Spring Wheat Region because of climatic and agronomic similarities, albeit APU 20 has a slightly drier climate and smaller fields. The large-scale collective farming practices in the Ural Region have resulted in field sizes in excess of 400 hectares, whereas the smaller strip and block fields of North Dakota and Minnesota seldom exceed 24 hectares.

Table 3-5 provides the climatological and agronomic characteristics of APU 20 in comparison to the Ural Region. The similarity of the nominal crop growth stages for spring small grains in APU 20 compared to these in the Ural Region can be seen in figure 3-3. Spring grains are planted (nominally) a week later in the Ural Region than in APU 20, reflecting the slightly colder climate (table 3-5).

The LACIE Phase III transition year and 1979 segments with available APU 20 ground truth are listed in tables 3-6, 3-7, and 3-8. The average percentage of wheat, barley, oats, and flax for the segments in APU 20 are also given. Table 3-9 gives the acquisition history for the intensive test sites in APU 20. Tables 3-10 and 3-11 give the acquisition history for the intensive test site in Polk County, Minnesota (sample segment 1987) and the usual planting and harvesting dates for the major crops found in Polk County. Table 3-12 gives the temperature and precipitation data for Polk County, and table 3-13 gives the available acquisitions with ground truth for the intensive test site.

TABLE 3-4.- PHASE III BLIND SITES AND AVERAGE GROUND TRUTH GRAIN PERCENTAGES IN MONTANA APU 104

State	Segment number	CRD	APU	County	APU 104 average percent barley	APU 104 average percent spring wheat	APU 104 average percent winter wheat	APU 104 average percent oats	APU 104 average percent flax
Montana	1102	80	104	Yellowstone	3.4	.6	4.7	-	—
Montana	1104	90	104	Rosebud	2.0	0	7.8	2.7	—
Montana	1725	10	104	Flathead	14.9	1	5.0	2.3	—
Montana	1750	70	104	Gallatin	18.3	.1	4.4	.6	—
Montana	1752	80	104	Park	5.4	1.5	12.0	.9	—
Montana	1753	80	104	Stillwater	2.8	.8	11.8	.9	—
Montana	Average percent APU 104		104		7.8	.7	7.6	1.2	—

TABLE 3-5.- NORTH DAKOTA AND MINNESOTA APU 20 COMPARED TO URAL BARLEY AND SPRING WHEAT REGION

	North Dakota and Minnesota APU 20	Ural Region, Orenburg
Climate	Cold Continental steppe Dry, little winter precipitation Short warm summers, and long cold winters Average January temperature: -20° C Average July temperature: +21° C Average annual precipitation: 500 mm Mean annual snow cover: 130 days First killing frost: late September Last killing frost: mid-May	Cold Continental steppe Dry Short warm summers, and long cold winters Average January temperature: -17° C Average July temperature: +20° C Average annual precipitation: 329 mm Mean annual snow cover: 160 days
Agronomy	Major small grains present: Barley: 13.3% Spring wheat: 27.6% Winter wheat: 0.1% Other grains: 16.5% (Percentage of blind site area) Other crops present: Potatoes, sugar beets, soybeans, clover, corn flax, sunflowers, alfalfa, rye Little irrigation Field size: 24 hectares Fallowing is practiced extensively Crop rotations: Three years for small grain, one year for corn and beets	Major small grains present: Barley: 15% Spring wheat: 35% Winter wheat: .4% Oats: 10% Rye: 4% (Percentage of sown crops) Other crops present: Millet Field size: 200-400 hectares Fallowing is every fourth year Arable land mixed with grazing and for dairy cattle
Geomorphology	Red River Valley makes up most of this stratum Ancient Glacial Lake Basin Elevation approximately 1000 feet	Plains of Turgay Plateau and Kazath upland Ancient dissfected peneplain Elevation approximately 1100 feet
Geology	Glacial sediment Flood plain sands and gravels along red river	Exposed rock, sediments of clays, shales, and sandstone
Native vegetation	Bluestem grass	Fescue-feathergrass steppe communities Scattered patches of wood steppe and pine forest; also flood plain meadows and shrubs
Soils	Mollisol, aquoll, haplaquoll Textures are loamy rich, organic Color ranges from black to dark gray Poor drainage	High clay soils Brown color Salinity is a problem in flats and depressions

TABLE 3-6.- LACIE PHASE III BLIND SITES AND INTENSIVE TEST SITES IN NORTH DAKOTA AND MINNESOTA APU 20

State	Segment number	APU	County	Flax	APU 20 average percent barley	APU 20 average percent spring wheat	APU 20 average percent winter wheat	APU 20 average percent oats	Comments
N. Dak.	1619	20	Grand Forks	.53	10.04	41.1	.06	1.06	
N. Dak.	1644	20	Steele	1.8	15.9	26.6	--	9.37	
N. Dak.	1663	20	Richland	1.67	14.0	32.3	--	3.9	
N. Dak.	1899	20	Walsh	.48	30.1	28.6	--	.15	
Minn.	1514	20	Marshal	--	--	--	--	--	No ground truth
Minn.	1825	20	Norman	--	--	--	--	--	No ground truth
Minn.	1512	20	Clay	1.8	8.0	12.5	.03	11.4	
Minn.	1513	20	Kittson	.49	19.3	52.3	--	--	
Minn.	1515	20	Norman	--	19.0	38.3	.17	4.8	
Minn.	1521	20	Grant	1.79	7.1	38.9	--	5.1	
Minn.	1523	20	Wilkin	.12	10.5	20.2	.08	8.6	
Minn.	1830	20	Red Lake	.25	10.1	36.7	.1	10.2	
Minn.	1987	20	Polk (ITS)	--	--	--	--		
APU 20 Average crop percentage	--	--	--	.89	14.4	32.6	.06	5.5	

TABLE 3-7.- TRANSITION-YEAR BLIND SITES AND DIGITIZED GROUND TRUTH IN NORTH DAKOTA AND MINNESOTA APU 20

State	Segment number	APU	County	APU 20 average percent barley	APU 20 average percent spring wheat	APU 20 average percent winter wheat	APU 20 average percent other grains	APU 20 average 209 dot count oats	rye	flax	Comments
N. Dak.	1565	20	Pembina								No ground truth
N. Dak.	1584	20	Pembina	19.9	30.0	0	21.6	.5	0	1.9	Good acquisition
N. Dak.	1586	20	Grand Forks								No ground truth
N. Dak.	1618	20	Grand Forks								Not workable
N. Dak.	1619	20	Grand Forks	11.5	35.7	0	12.2	.5	0	0	Good acquisition
N. Dak.	1621	20	Pembina								No ground truth
N. Dak.	1624	20	Walsh								No ground truth
N. Dak.	1641	20	Cass								No ground truth
N. Dak.	1642	20	Cass								No ground truth
N. Dak.	1645	20	Traill								No ground truth
Minn.	1829	20	Kittson								No ground truth
Minn.	1825	20	Norman	4.9	12.9	0.1	13.7	16.9	.4	0	Good acquisition
Minn.	1830	20	Red Lake								No ground truth
Minn.	1841	20	Wilkin								No ground truth
N. Dak.	1473	20	Cass	17.0	31.7	0	13.6	0	0	1.0	Good acquisition
APU 20 average crop percentages				13.3	27.6	0	16.5	4.5	0	.7	

TABLE 3-8.- 1979 BLIND SITES IN NORTH DAKOTA AND MINNESOTA APU 20

State	Segment number	APU	County	APU 20 average percent barley	APU 20 average percent spring wheat	APU 20 average percent winter wheat	APU 20 average percent oats	APU 20 average percent flax	APU 20 average percent rye
N. Dak.	1584	20	Pembina	Crop proportions not available at publication time.					
N. Dak.	1619	20	Grand Forks						
N. Dak.	1473	20	Cass						
N. Dak.	1645	20	Trail						
N. Dak.	1399	20	Richland						
N. Dak.	1974	20	Ransom						
Minn.	1514	20	Marsh						
Minn.	1518	20	Roseau						
Minn.	1825	20	Norman						
Minn.	1987	20	Polk (ITS)						

TABLE 3-9.- AVAILABLE ACQUISITIONS FOR NORTH DAKOTA APU 20 BLIND SITES

Segment	CRD	County	Ground truth						Acquisitions
			Phase I 1975	Phase II 1976	Phase III 1977	1978	1979	1980	
1473	60	Cass				X	X		9201, 9220, 9264, 9273 (Acquisition listed but not in printout: 6127, 6145, 6163, 6181, 6199, 6217, 6235, 8116, 8197, 8207, 8224, 8242, 8251, 8269)
1584	30	Pembina				X	X		8117, 8135, 8198, 8216, 8243, 9175 Clouds: 8153, 9112, 9148, 9175
1618	30	Grand Forks		X					5133, 6127, 6128, 6145, 6146, 6163, 6182, 6199, 6200, 6235, 6236, 6253, 6254, 7122, 7140, 7157, 7158, 7175, 8116, 8134
1619	30	Grand Forks			X	X	X		5187, 5205, 6127, 6128, 6145, 6163, 6181, 6217, 6235, 6236, 6254, 7122, 7140, 7158, 7175, 7212, 7158, 7230, 8135, 8207, 8216, 8243, 8252, 8270, 9112, 9148, 9166, 9175, 9202, 9220, 9229, 9301. Clouds: 5233, 6253, 7176, 8198.
1624	30	Walsh		X					5169, 5187, 5223, 6110, 6128, 6146, 6236, 6254, 7122, 7140, 7158, 7212, 7230, 8135, 8198, 8207, 8216, 8243, 8252, 8270
1642	60	Cass		X					5115, 6127, 6128, 6145, 6146, 6163, 6182, 6199, 6200, 6236, 7122, 7139, 7140, 7158, 7175, 7193, 7194, 7211, 7229, 8098, 8116, 8117, 8134, 8135, 8197, 8216, 8224, 8233, 8242, 8251, 8252, 8270
1644	60	Steele			X				6127, 6145, 6163, 7122, 7140, 7158, 6199
1645	60	Trail		?		X	X		5222, 6110, 6127, 6128, 6145, 6146, 6164, 6181, 6235, 7175, 8116, 8135, 8242, 8251, 8252, 9112, 9148. Clouds or misregistered: 5132, 7157, 8098, 8198, 8270, 911
1633	90	Richland	X		X				5132, 5186, 6127, 6144, 6162, 7121, 7138, 7156, 7157, 7174, 7175, 7193, 7211, 7229. Clouds: 6163
1899	30	Walsh			X				7122, 7140, 7157, 7175, 7193
1974	90	Ransom					X		8008, 8117, 8134, 8135, 8197, 8198, 8107, 8224, 8243, 8269, 8270, 9004, 9057, 8112, 9148, 9202, 9220, 9274, 8116, 8206

TABLE 3-10.- AVAILABLE ACQUISITIONS FOR MINNESOTA APU 20 BLIND SITES

Segment	CRD	County	Ground truth						Acquisitions
			Phase I 1975	Phase II 1976	Phase III 1977	1978	1979	1980	
1513	10	Kittson		X	X				5223, 6127, 6145, 6153, 6161, 6236, 7140, 7157, 7157, 7193, 7230
1512	10	Clay		X					5186, 5222, 5240, 6145, 6163, 6199, 6217, 6235, 7120, 7156, 7157, 7174, 7193
1514	10	Marshall			X	X	X		5132, 6127, 6145, 6163, 6199, 6235, 7125, 8116, 8206, 8224, 8242, 8251, 9111, 9201, 9219, 9237
1515	10	Norman		X	X				5186, 55240, 6235, 7157, 7175, 7193, 8116, 8224, 8251
1518	10	Roseau				X	X		5132, 5186, 5222, 6127, 6145, 6163, 6199, 6235, 7157, 7175, 7193, 8135, 8153, 8211, 8224, 8243, 9201, 9219, 9220. Clouds: 8116, 8188, 8206, 8260, 9111, 9238, 9112
1521	40	Grant		X	X	Changed locations			5131, 5132, 5149, 5185, 5203, 5221, 5239, 5240, 6108, 6144, 6162, 6234, 7120, 7138, 7156, 7174, 7210. New Location: 8115, 8116, 8133, 8134, 8169, 8196, 8197, 8205, 8215, 8214, 8233, 8224, 8750. Clouds: 8167, 8206
1523	40	Wilkin			X				5131, 6127, 6144, 6162, 6235, 7120, 7121, 7138, 7156, 7174, 7175, 7210, 7229
1825	10	Norman			X	X	X		7120, 7138, 7139, 7156, 7157, 7175, 7193, 7211, 8097, 8133, 8169, 8196, 8206, 8223, 8228, 8232, 8242, 8250, 8251, 9111, 9146, 9164, 9191, 9209, 9237
1830	10	Red Lake			X				7175, 7211, 8116, 8206, 8224

TABLE 3-11.- USUAL PLANTING AND HARVESTING DATES BY CROPS FOR MINNESOTA

Crop	Usual planting dates	Usual harvesting dates		
		Begin	Most active	End
Barley	Apr. 15-May 30	July 25	Aug. 1-20	Sept. 10
Corn:				
Grain	May 1-June 15	Oct. 5	Oct. 20-Nov. 15	Nov. 30
Silage	May 1-June 15	Sept. 5	Sept. 20-30	Oct. 15
Forage	May 1-June 15	Oct. 5	Oct. 10-Nov. 10	Nov. 30
Flaxseed	Apr. 25-June 15	Aug. 15	Aug. 25-Sept. 30	Nov. 10
Hay:				
Alfalfa		June 5		Aug. 30
Clo-tim		June 10		Aug. 30
Wild		July 10		Aug. 30
Oats	Apr. 10-May 25	July 25	Aug. 1-20	Sept. 10
Peas, dry	Apr. 20-June 1	Aug. 10	Aug. 25-30	Sept. 20
Rye	Sept. 1-30	July 25	Aug. 1-10	Aug. 15
Soybeans	May 15-June 15	Sept. 25	Oct. 10-25	Nov. 10
Sugar beets	Apr. 25-May 30	Sept. 20	Oct. 10-30	Nov. 10
Wheat:				
Winter	Sept. 1-30	July 25	Aug. 1-10	Aug. 15
Spring	Apr. 15-May 30	July 25	Aug. 1-20	Sept. 10
Durum	Apr. 15-May 30	July 25	Aug. 1 20	Sept. 10
Seed crops:				
Alfalfa		Sept. 5	Sept. 20-Oct. 1	Oct. 25
Red clover		Sept. 5	Sept. 5-Oct. 5	Oct. 15
Sweetclover		Aug. 5	Aug. 10-Sept. 5	Oct. 10
Timothy		Aug. 1	Aug. 7-20	Aug. 30
Kentucky bluegrass		July 1	July 1-10	July 15

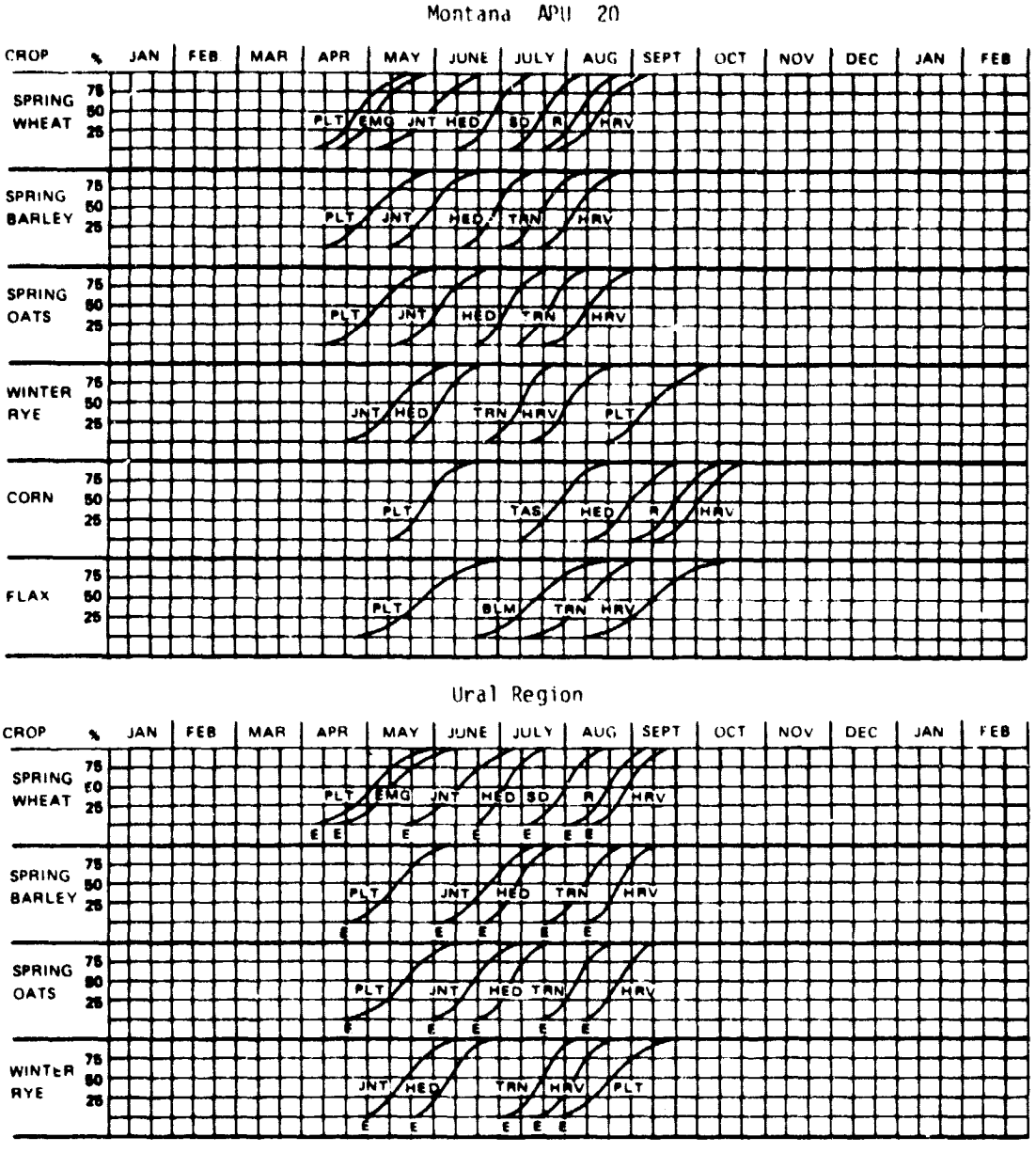
TABLE 3-12.- AVERAGE[a] MONTHLY, SEASONAL, AND ANNUAL TEMPERATURE AND PRECIPITATION AT CROOKSTON NW EXPERIMENT STATION, POLK COUNTY, MINNESOTA

Month	Temperature average, °F	Precipitation average, inches
December	12.1	0.62
January	5.0	0.59
February	9.4	0.59
Winter	8.83	1.80
March	23.0	1.00
April	41.1	1.49
May	54.7	2.60
Spring	39.6	5.09
June	63.7	3.43
July	70.3	2.80
August	68.0	3.13
Summer	67.33	9.36
September	57.4	1.93
October	45.8	1.16
November	26.8	0.92
Fall	43.33	4.01
Year	39.8	20.27

[a]Averages for period 1931-1955.

TABLE 3-13.- LACIE PHASE I, II, AND III AVAILABLE ACQUISITIONS WITH GROUND TRUTH FOR POLK COUNTY, MINNESOTA, INTENSIVE TEST SITE

Segment number	LACIE Phase I			LACIE Phase II			LACIE Phase III		
	Acquisition date	Sun angle, degree	Satellite	Acquisition date	Sun angle, degree	Satellite	Acquisition date	Sun angle, degree	Satellite
1987	5151	56	2	5312	22	2	7121	48	2
1987	5186	56	2	6127	51	2	7175	54	2
1987				6145	55	2	7193	52	2
1987				6163	56	2	7211	49	2
1987				6181	56	2			
1987				6199	53	2			



LEGEND

E	Under stage name, indicates rough estimate of date
EMG	Emergence
HED	Heading
HRV	Harvest
JNT	Jointing
PLT	Planting
R	Ripe
SD	Soft dough
TRN	Turning
TAS	Tasseling
BLM	Blooming

Figure 3-3.- Nominal crop calendars for Montana and the Ural RSFSR Barley and Spring Wheat Region.

3.2.2 SOUTHERN MANITOBA AND SASKATCHEWAN, CANADA (SECONDARY REGION)

The Southern Manitoba and Saskatchewan Region was chosen as a secondary region of study for similarity with the Ural Region because the Canadian barley and spring wheat fields, which are larger than those in APU 20, compare more favorably in size with the huge Soviet fields (table 3-14). The climates of the two regions are similar, and both regions grow barley and spring wheat as the major crops with similar secondary crops. The proportion estimates derived from 600-dot ground truth counts of 15 transition-year Canadian test sites for barley and spring wheat are barley, 3.8 percent, and spring wheat, 38.8 percent (ref. 4). This indicates that there is less barley grown in the Southern Manitoba and Saskatchewan Region than in North Dakota and Minnesota APU 20 (13.3 percent), according to the transition-year ground truth.

The LACIE Phase I, II, and III intensive test sites are listed in table 3-15 for Saskatchewan and in table 3-16 for Manitoba. Intensive test site data for Manitoba and Saskatchewan have not been collected for the growing seasons since 1977 (LACIE Phase III). The available acquisitions for the Manitoba and Saskatchewan Intensive Test Sites are given in tables 3-17 and 3-18, and the blind site ground truth data collected for 29 Saskatchewan segments for 1978 and 1979 are listed in table 3-19 (ref. 5).

The similarity of the nominal crop growth stages for spring small grains in Manitoba and Saskatchewan is even closer to those in the Ural Region than was noted for APU 20 (figs. 3-3 and 3-4). Spring wheat is planted (nominally) in early May in both the Southern Manitoba and Saskatchewan Region and the Ural Region. Barley is planted approximately a week to ten days later in both of the paired regions. The jointing, heading, and turning stages are also approximately the same for both grain types in each region. However, there is considerable variation in the harvesting periods as can be seen from figure 3-4.

TABLE 3-14.- SOUTHERN MANITOBA AND SASKATCHEWAN (SECONDARY REGION) COMPARED TO URAL BARLEY AND SPRING WHEAT REGION

	Manitoba/Saskatchewan	Ural Region, Orenburg
Climate	Continental steppe Cold, dry Short warm summers, long cold winters Average January temperature: -15.6° C Average July temperature: +18.9° C Average annual precipitation 368.3 mm Mean annual snow cover: significant moisture deficits within growing season	Continental steppe Cold, dry Short warm summers, long cold winters Average January temperature: -17° C Average July temperature: +20° C Average annual precipitation: 329 mm Mean annual snow cover: 160 days
Agronomy	Major small grains present: Barley: 14.6% Spring wheat: 11.8% Oats: 3.9% Rye: .33% Other small grains: .39% Other crops present: Hay: 2.5% Sunflower: 4.6% Pasture: 2.3% Flax: 1.2% (Percentage of area from Manitoba 1971 census land use) Field size: 20-260 hectares Dry land farming Strip cropping Many crop rotations Fallow: 25%	Major small grains present: Barley: 15% Spring wheat: 35% Oats: 10% Rye: 4% Other crops present: Millet (Percentage of sown crops, ref. 1) Field size: 200-400 hectares Fallowing every fourth year Arable land mixed with grazing land for dairy cattle
Geomorphology	Interior drainage Small intermittent lakes Elevation approximately 2000 feet	Plains of Turgay Plateau and Kazakh uplands Ancient dissected peneplain Elevation approximately 1100 feet
Geology	Postglacial drainage Rock outcrops	Exposed rocks, sediments of clays, shales, and sandstone
Soils	Black chernozem Alkaline	High clay soils Brown color Salinity is a problem in flats and depressions
Native vegetation	TBD	Fescue-feathergrass steppe communities Scattered patches of wooded steppe and pine forest Floodplain meadows and shrubs

TABLE 3-15.- SASKATCHEWAN INTENSIVE TEST SITES

Segment	County	Site size in miles
	Phase I	
1984	Delisle	2 x 10
1985	Swift Current	2 x 10
	Phase II	
1984	Delisle	
1958	Melfort	
1985	Swift Current	
1996	Torquay	
	Phase III	
1958	Melfort	2 x 10
No Landsat imagery or segment number	Torquay	1 x 5

TABLE 3-16.- LACIE PHASES I, II, AND III MANITOBA INTENSIVE TEST SITES

Segment	Province	County	Center coordinates	Kilometers	Miles
1990	Manitoba	Stony Mountain	50°04'N 97°21'W	3.2 x 16	2 x 10
1991	Manitoba	Starbuck	49°47'N 97°29'W	3.2 x 16	2 x 10
1995	Manitoba	Altona	49°12'N 97°38'W	1.6 x 8	1 x 5

TABLE 3-17.- AVAILABLE ACQUISITIONS FOR MANITOBA INTENSIVE TEST SITES

Segment	1990	1991	1995
Phase I 1974-1975 Acquisitions			
Phase II 1975-1976 Acquisitions	6128 6129 6146 6182 6183 6200 6218 6219 6236 6237 6254 6255 6272 6273	6128 6129 6146 6182 6183 6200 6218 6219 6236 6237 6254 6255 6273	6110 6128 6129 6146 6182 6200 6254
Phase III 1976-1977 Acquisitons	7122 7140 7141 7159 7230	7122 7140 7141 7159 7230	7122

TABLE 3-18.- AVAILABLE ACQUISITIONS FOR SASKATCHEWAN INTENSIVE TEST SITES

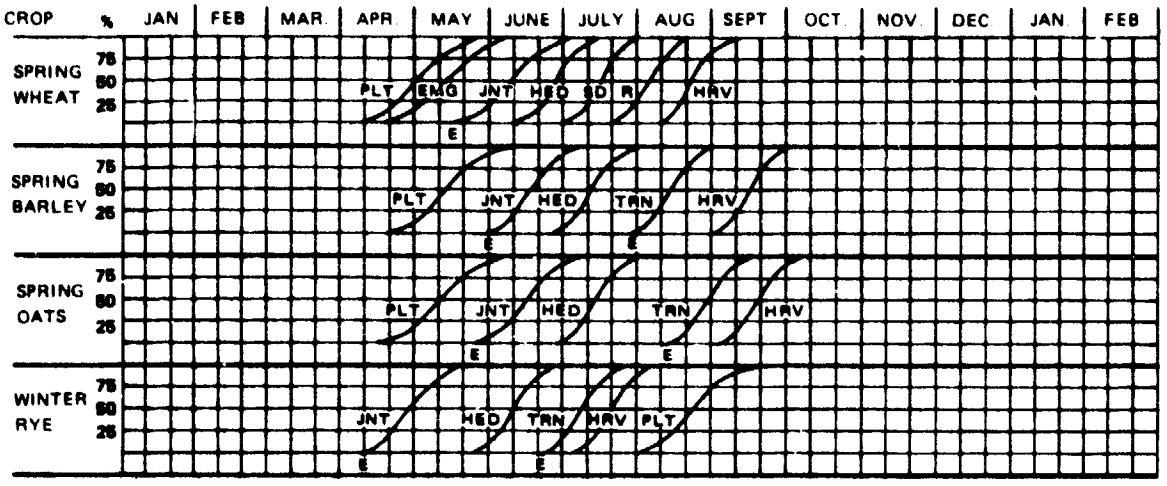
Segment	1958	1984	1985
Phase I 1974-1975 Acquisitions		5195	5141
Phase II 1975-1976 Acquisitions	6170 6188 6189 6207 6224 6243 6261	6189 6243 6244 6261 6262	6117 6153 6225
Phase III 1976-1977 Acquisitions	7128 7129 7182 7237 7254 7272 7273	7111 7112 7129 7130 7184 7202 7220 7238	7112 7130 7148 7184 7201 7202 7220 7237

TABLE 3-19.- SASKATCHEWAN BLIND SITES AND AVAILABLE ACQUISITIONS

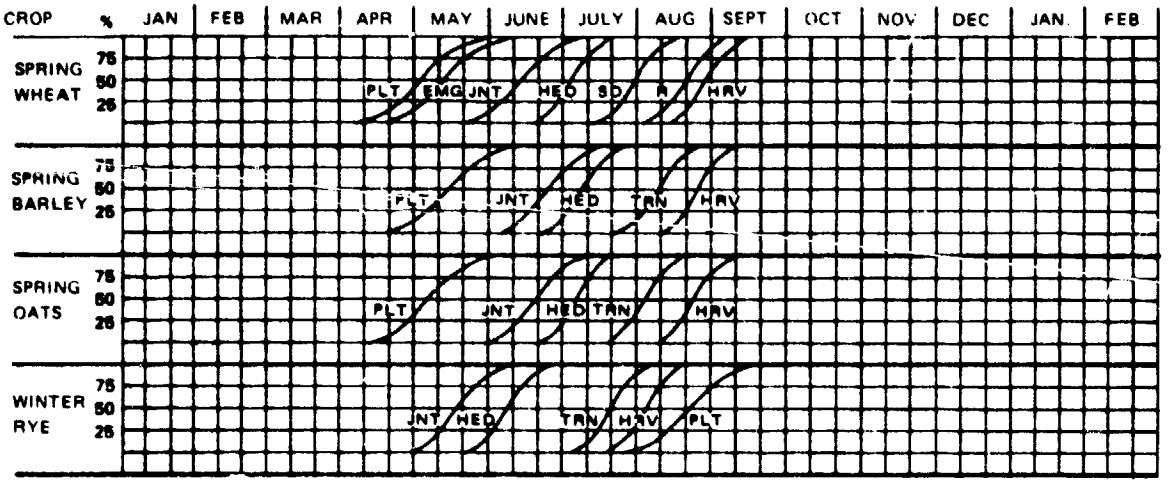
Segment	Name	Acquisitions
3050	Carnduff	9188, 9214, 9223, 9232, 9242, 9250, 9259, 9268, 9260
3053	Hitchcock	9117, 9225, 9233, 9242, 9251, 9260, 9269, 9278
3064	Ceylon	9117, 9135, 9172, 9181, 9199, 9208, 9261, 9262, 9271, 9275
3075	Coronach	9135, 9171, 9180, 9181, 9199, 9207, 9208, 9226, 9261, 9262
3080	Reliance	9119, 9143, 9182, 9191, 9200, 9209, 9218, 9272
3083	Lakenheath	9119, 9173, 9181, 9182, 9199, 9200, 9209, 9218, 9227, 9244, 9245, 9262, 9273, 9292
3093	Canuck	9119, 9174, 9191, 9201, 9209, 9218, 9219, 9246, 9263, 9272
3099	Illerburn	9246, 9273
3109	Fenwood	9135, 9153, 9233, 9242, 9261, 9269, 9278
*3112	Regina	8141, 8158, 8194, 8195, 8212, 8230, 8231, 8248, 8266
3130	Central Butt	9143, 9182, 9191, 9209, 9218, 9245, 9263, 9272
3132	Craig	9119, 9135, 9209, 9218, 9226
3144	Burstall	9139, 9145, 9184, 9202, 9220, 9249, 9247
3147	Glidden	9175, 9202, 9265
3151	Dneiper	9135, 9153
3159	Lestock	9117, 9153, 9199, 9208, 9217, 9226
3163	Lanigan	9136, 9166, 9191, 9199, 9208, 9209, 9217
3165	Cutbank	9188, 9191, 9192, 9201, 9209, 9208
3166	Simpson	9136, 9191, 9199, 9200, 9208, 9209, 9217, 9218, 9226, 9245, 9262
3269	Outlook	9168, 9173, 9182, 9191, 9192, 9200, 9201, 9209, 9218, 9291, 9227, 9245, 9246
3175	Malgren	9175, 9184, 9192, 9201, 9202, 9246, 9295
3179	Perdue	9139, 9192, 9201, 9202, 9211, 9219, 9229, 9246
3185	Luseland	9175, 9184, 9202, 9256, 9265, 9266
3192	Greenwater Lake	9195, 9199, 9207, 9208, 9256, 9261
3197	Carrot River	9133, 9199, 9207, 9208, 9226, 9261, 9262
3201	Bremen	9191, 9209, 9218, 9245
3207	Blaine Lake	9138, 9191, 9201, 9209, 9210, 9218
3214	Lashburn	9266
3218	Whitewood	9169, 9179, 9197, 9242

*Segment 3112 has ground truth available for 1979 only.

Saskatchewan, Canada



Ural Region



LEGEND

E	Under stage name, indicates rough estimate of date
EMG	Emergence
HED	Heading
HRV	Harvest
JNT	Jointing
PLT	Planting
R	Ripe
SD	Soft dough
TRN	Turning

Figure 3-4.- Nominal crop calendars for Saskatchewan, Canada, and the Ural RSFSR Barley and Spring Wheat Region.

3.3 BARLEY AND WINTER WHEAT REGION

3.3.1 MONTANA AGROPHYSICAL UNIT 23

Montana APU 23 was chosen as the primary barley and winter wheat similarity region for the North Caucasus RSFSR Region. A climatic and agronomic comparison of APU 23 with the North Caucasus Region is given in table 3-20. Both regions have cold winters with periods of mild weather. APU 23 has colder annual temperatures and less annual precipitation than does the North Caucasus Region. Although APU 23 has less rainfall, approximately one-half of the total annual rainfall is during May through July, when it is most needed. In comparison, there is a 15- to 35-percent chance of a drought in the North Caucasus Region between May and July.

The nominal crop calendars for the two regions are both similar and dissimilar in certain respects. The colder average temperature for Montana indicates why the nominal crop calendars show the growth stages for small grains, from planting through harvest, occurring earlier in the year in APU 23 than in the North Caucasus Region (tables 3-21 and 3-22, figs. 3-5 and 3-6, ref. 6). However, the approximate number of days in each growth stage are equivalent for small grains in both regions. Barley is indicated as being slightly ahead of spring wheat in both regions.

Agronomically, winter wheat is the major small grain in both APU 23 and the North Caucasus Region. Barley follows winter wheat in importance in the North Caucasus Region. Barley and spring wheat are the second most important small grains in APU 23, but they are grown in smaller proportions than in the North Caucasus Region (table 3-20). Although strip cropping is found in both regions, it is more extensive in APU 23. The average field size in the North Caucasus Region is extremely large compared to that of APU 23, and the fields are usually rectangular in shape.

The available ground truth for APU 23 appears adequate for the initial experiment design and testing phase of AgRISTARS. Table 3-23 provides the blind site segments within APU 23, showing the years for which ground truth is

TABLE 3-20.- MONTANA APU 23 COMPARED TO NORTH CAUCASUS BARLEY AND WINTER WHEAT REGION

	Montana APU 23	North Caucasus
Climate	Semiarid, true continental climate Cold winters with spells of mild weather due to chinook winds Warm summers with moderate to low humidities Most spring and summer precipitation falls as showers Occasional steady rains in May and June and again in September One half of total annual rainfall occurs during May through July when it is most needed Average January temperature: -9.5° C Average July temperature: +19.1° C Average annual precipitation: 337.3 mm Frost free period from 116 to 140 days Snow cover: 100-120 days (refs. 4 and 5)	Semiarid Cold to mild winters, thin snow cover Snow retention required to prevent winter kill Warm summers with a mean relative humidity of 61 percent 15 to 35 percent chance of drought between May and July Summer has slightly less precipitation than winter Mean minimum winter temperature: -5.6° C Mean maximum temperature during growing season: +25.6° C Average annual precipitation: 508 mm Snow cover: 50-70 days (ref. 4) Average January temperature: -4.4° C Average July temperature: 18° C
Agronomy	Major small grains present: Barley: 2.9 Winter wheat: 23.5 Spring wheat: 3.9 Oats: .9 Hay: 1.6 (Percentages for Hill County, Montana, from ancillary summary) Other crops present: Alfalfa, flax Large farmsteads utilizing strip cropping In eastern part of stratum, most of the land is range or dry Farmed for wheat Narrow strips along Missouri River are irrigated for hay, corn, pastures, and sugar beets Wheat grown in fallow-wheat rotation Harvested by direct combining or swathing	Major small grains present: Barley: 14.8 Winter wheat: 32.9 Spring wheat: 0.2 Oats: 1.1 Rye: 1.0 Other grain: 2.5 (Percentage of sown crops in 1977) Other crops present: Corn, sugar beets, sunflowers, millet Large scale collective farms Strip cropping and some irrigation post-harvest scuffling, subsurface plowing to retain water and destroy weeds Snow retention
Geomorphology	Great continental slope Level to gently rolling glaciated plan Elevations from 2000 to 4000 feet from east to west	Plains and foothills Elevations of 500 to 2500 feet
Geology	Continental glacial underlain by shales and sandstone Outcrops of igneous and metamorphic rocks	Stavropol plateau composed of uplifted tertiary strata: clays, sands, shales, sediments, and outcrops of igneous rock
Soils	Mollisols, entisols Clay loam, silt loams, loams Grayish brown color	Black (west) and chestnut brown (east) soil
Native vegetation	Grama, needle, and wheat grass	Virgin steppe (mostly plowed for agriculture)

TABLE 3-21.- PRINCIPAL CROPS GROWN IN THE NORTH-CENTRAL CROP REPORTING DISTRICT OF MONTANA

Crop	Seedbed preparation			Full coverage			Heading, flowering			Postharvest operations		
	Start	Midpoint	End	Start	Midpoint	End	Start	Midpoint	End	Start	Midpoint	End
Winter wheat	Aug. 20	Sept. 10	Sept. 30	May 01	May 10	May 20	June 05	July 05	July 20	Aug. 20	Oct. 01	Oct. 30
Durum wheat	May 26	Apr. 25	May 15	May 21	June 02	June 09	July 21	July 23	Aug. 15	Sept. 10	Oct. 01	Oct. 30
Spring wheat	Mar. 27	Apr. 23	May 14	May 20	June 01	June 08	June 20	July 21	Aug. 15	Sept. 10	Oct. 01	Oct. 30
Rye	Aug. 20	Sept. 10	Sept. 30	May 01	May 10	May 20	June 10	July 05	July 20	Aug. 20	Oct. 01	Oct. 30
Oats	Mar. 25	Apr. 20	May 15	May 20	June 01	June 10	June 22	July 24	Aug. 20	Sept. 10	Oct. 01	Oct. 30
Barley	Mar. 25	Apr. 20	May 15	May 19	May 29	June 08	June 18	July 16	Aug. 10	Sept. 10	Oct. 01	Oct. 30

TABLE 3-22.- USUAL PLANTING AND HARVESTING DATES BY CROPS AND PRINCIPAL PRODUCING AREAS IN MONTANA

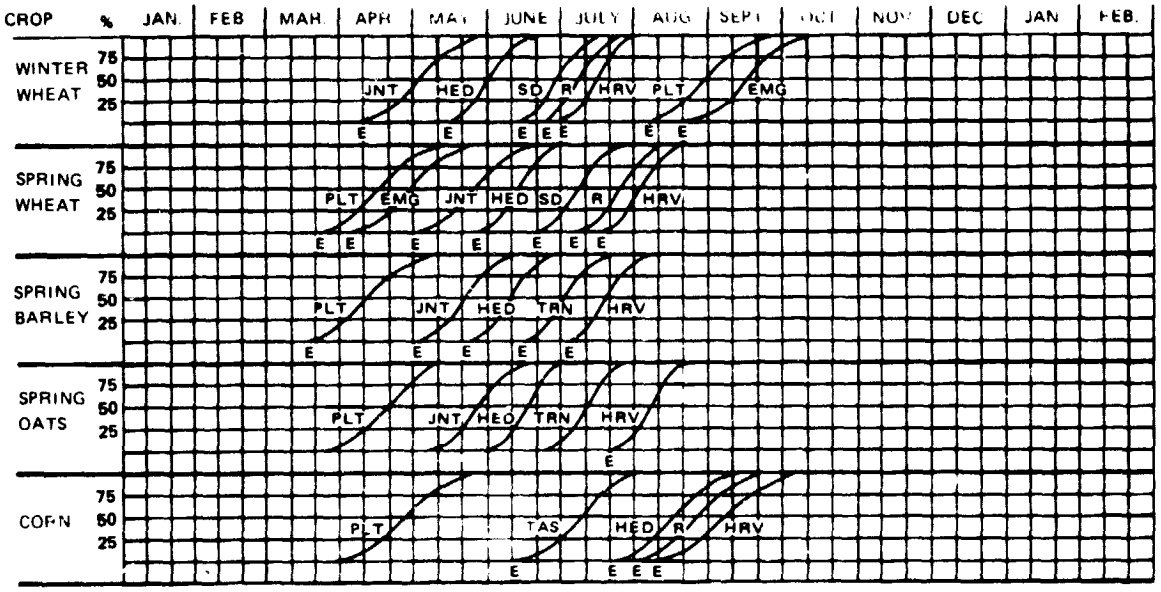
[From ref. 6]

Crop	Usual planting dates	Usual harvesting dates			Principal producing areas and counties
		Begin	Most active	End	
Beans, dry	May 10-June 10	Aug. 25	Sept. 10-Oct. 1	Oct. 5	3,8
Corn:					
Grain	May 10-June 10	Sept. 15	Sept. 20-Oct. 5	Oct. 15	Statewide
Silage	May 10-June 10	Sept. 1	Sept. 5-20	Oct. 5	Statewide
Forage	May 10-June 10	Sept. 5	Sept. 10-25	Oct. 1	3,9
Flaxseed	May 5-June 10	Aug. 20	Sept. 5-5	Oct. 5	2,3
Hay:					
Alfalfa		June 15		Sept. 20	Statewide
Clo-tim		June 25		Sept. 15	Statewide
Wild		July 5		Sept. 15	Statewide
Sugar beets	Apr. 5-May 20	Oct. 1	Oct 5-25	Nov. 5	Statewide
Seed crops:					
Alfalfa		Sept. 5	Sept. 15-Oct. 5	Oct. 15	Statewide
Crested wheatgrass		Aug. 1	Aug. 10-25	Sept. 1	2, 3, 5, 8, 9
Mustard		Aug. 25	Sept. 5-25	Oct. 10	2

TABLE 3-23.- AVAILABLE ACQUISITIONS FOR MONTANA APU 23 BLIND SITES

Segment	CRD	County	Ground truth						Acquisitions
			Phase I 1975	Phase II 1976	Phase III 1977	1978	1979	1980	
1529	20	Blaine			X				5158, 6316, 6351, 6352, 7058, 7075, 7076, 7112, 7129, 7147, 7148, 7184, 7201, 7202, 7220
(1531)	20	Phillips		X	X				5133, 5140, 6208, 6226, 6261, 6279, 6315, 6316, 6351, 7058, 7095, 7112, 7129, 7147, 7201, 7220
1729	20	Chouteau		X					5142, 5160, 5177, 5179, 5196, 5304, 5100, 6101, 6137, 6154, 6155, 6208, 6244, 6245, 6263, 6281, 6315, 7113, 7114, 7132, 7201, 7220
1730	20	Chouteau			X				5179, 5196, 5250, 5304, 6101, 6137, 6155, 6209, 6245, 263, 6281, 6299, 7059, 7113, 7149, 7203
1731	20	Chouteau				X			6209, 6213, 6245, 6261, 6281, 6290, 6314, 7059, 7113, 7131, 7149, 8131, 8207, 8208, 8216, 8235, 8241, 8252
1734	20	Hill			X				5196, 6209, 6245, 6263, 6281, 7059, 7095, 7113, 7203
1737	20	Pondera		X					5161, 5179, 5197, 5215, 5233, 5251, 6132, 6138, 6192, 6210, 6246, 6264, 6282, 6300, 6318, 6336, 7042, 7096, 7114, 7132, 7150, 7168, 7222
1739	20	Teton		X	X				5142, 5160, 5161, 5179, 5179, 5196, 5214, 5215, 5233, 6101, 6102, 6137, 6209, 6120, 6245, 6263, 6281, 6142, 7113, 7114, 7131, 7132, 7149, 7150, 7168, 7222
1741	20	Toole			X				5142, 5161, 5179, 5214, 5233, 5137, 6209, 6245, 6263, 6264, 6281, 6282, 6300, 6318, 6354, 7023, 7042, 7059, 7095, 7096, 7114, 7132, 7150, 7168, 7203
(1742)	50	Cascade		X	X	X			5142, 5179, 5304, 6101, 6137, 6191, 6209, 6245, 6263, 6281, 6299, 7113, 7167, 7203, 7257, 7293, 7311, 8207, 8216, 8252
(1747)	50	Judith Basin		X	X				5196, 5250, 5304, 5155, 6208, 6209, 6244, 6245, 631o, 7022, 7112, 7130, 7184
1829	20	Blaine			X				6261, 6279, 7076, 7112, 7129, 7147, 7148, 7184, 7201, 7202, 7220,
1837	20	Pondera			X				6263, 6264, 6281, 6282, 6299, 6300, 6317, 6318, 6354, 7023, 7059, 7096, 7113, 7114, 7132, 7168, 7203
1838	--	Teton				X			6264, 6282, 6300, 6318, 6354, 7042, 7113, 7132, 7186, 7294, 7311, 7312, 8181, 8208, 8217
1848	50	Fergus			X	X	X		5280, 6316, 6352, 7112, 7184, 8143, 8179, 8197, 8206, 8215, 8224, 8233, 8242, 8251, 8269, 8120, 8201, 8219, 8246

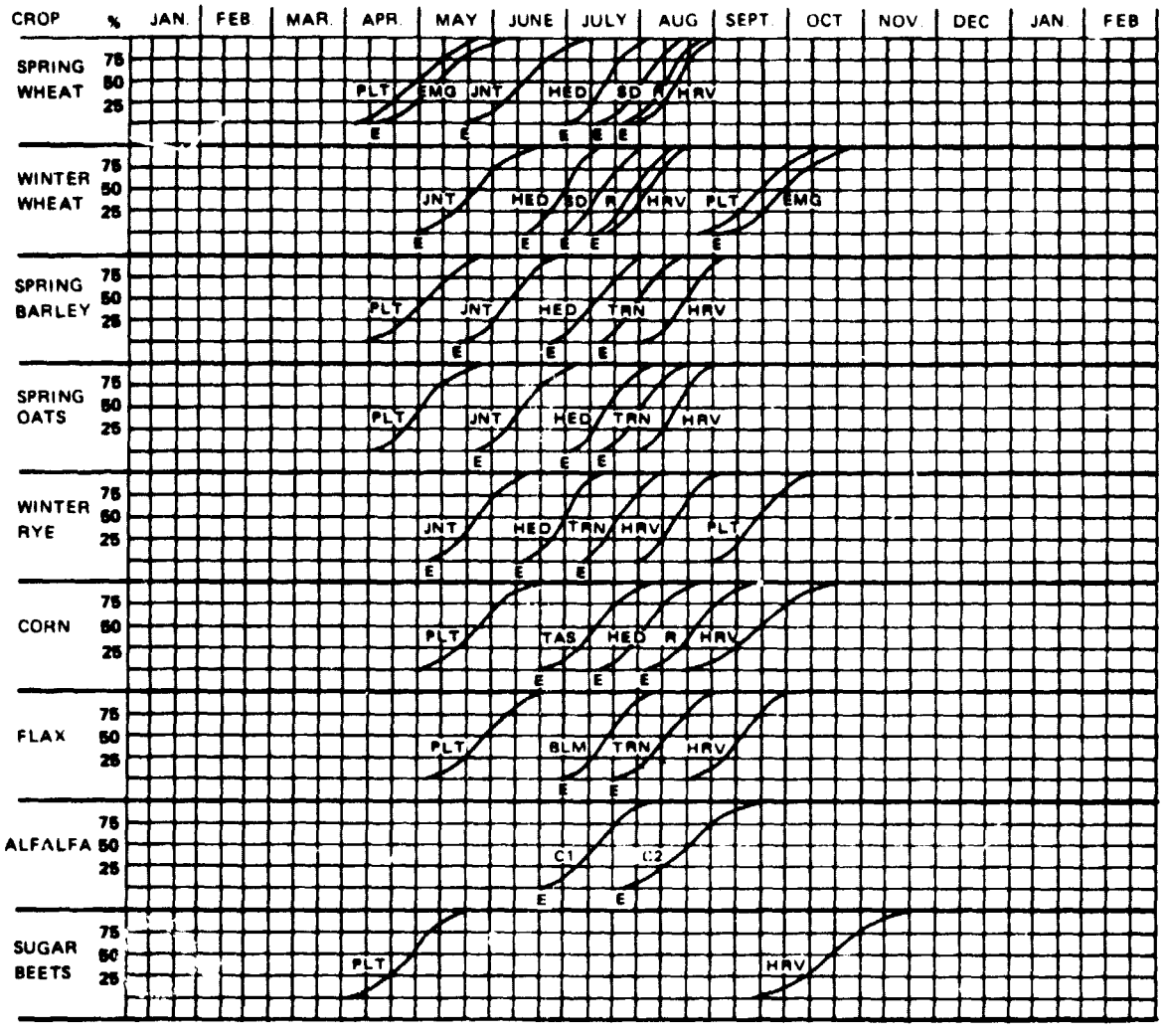
*Segment numbers in parenthesis fall near APU 23 boundaries and may or may not be actually located within APU 23.



LEGEND

E	Under stage name, indicates rough estimate of date
EMG	Emergence
HED	Heading
HRV	Harvest
JNT	Jointing
PLT	Planting
R	Ripe
SD	Soft dough
TRN	Turning
TAS	Tasseling

Figure 3-5.- Nominal crop calendar for the North Caucasus RSFSR Barley and Winter Wheat Region.



LEGEND

E	Under stage name, indicates rough estimate of date
EMG	Emergence
HED	Heading
HRV	Harvest
JNT	Jointing
PLT	Planting
R	Ripe
SD	Soft dough
TRN	Turning
C	Cust
TAS	Tasseling
BLM	Blooming

Figure 3-6.- Nominal crop calendar for Montana APU 23.

available as well as the available acquisition histories. The intensive test sites that fall within APU 23 are shown in tables 3-24 and 3-25.

The average proportion estimates derived from 11 Phase III barley and winter wheat blind sites in APU 23 for barley, wheat, oats, and flax are shown in table 3-26. Table 3-27 provides similar data on three transition year blind sites. The blind site ground truth verifies APU 23 as being a barley and winter wheat region. Supplemental data on planted areas for Liberty, Hill, and Toole Counties, Montana, are provided in tables 3-28, 3-29, and 3-30.

3.3.2 WHITMAN COUNTY, WASHINGTON (SECONDARY REGION)

Whitman County, Washington, was chosen as a similarity region for the North Caucasus Region because of similar climate, agronomy, and field sizes (table 3-31). One disadvantage of Whitman County as a similarity region is that there are no ground truth blind sites allocated. The three allocated intensive test sites in Whitman County had ground truth data collected for LACIE Phases I, II, and III (tables 3-32 and 3-33). These three sites were dropped subsequent to LACIE Phase III, and ground truth has not been collected since that time.

Although both regions are climatically similar according to the Modified Koppen Climatic Classification Scheme, variations in the nominal growth stages for barley and wheat are apparent (fig. 3-7). Winter wheat comes out of dormancy and enters the 50-percent jointing stage in mid-April in Whitman County, compared to early May in the North Caucasus Region.

Slight variations in the winter wheat growth cycle can be seen throughout the growing season until harvest, which occurs several weeks later in Whitman County than it does in the North Caucasus Region. The growth cycle for barley commences earlier in the year in Whitman County and continues ahead through harvest. Tables 3-34 and 3-35 provide more detailed growth stage data for small grains in Whitman County.

TABLE 3-24.- AVAILABLE ACQUISITIONS WITH GROUND TRUTH FOR MONTATA APU 23
INTENSIVE TEST SITES

Segment	County	Ground truth						Acquisitions
		Phase I 1975	Phase II 1976	Phase III 1977	1978	1979	1980	
1968	Glacier	X						NA
1969	Toole	X	X	X				5161, 5197, 5125, 5233, 5195, 5276, 6156, 6300, 6318, 7096, 7114, 7132, 7294
1970	Liberty	X	X	X				5304, 6101, 6102, 6137, 6227, 6245, 6263, 6264
1971	Hill	X	X	X	X			6136, 6137, 6155, 6208, 6227, 6244, 6245, 6263

TABLE 3-25.- LOCATION OF THE LACIE INTENSIVE TEST SITES IN MONTANA APU 23
[From ref. 6]

Sample segment	County	Sq. Mi.	Total acres	N. Lat.	W. Long.	Test site size, miles
1968	Glacier	2964.1	1 897 024	48° 37'	112° 33'	2 x 10
1971	Hill	2926.9	1 873 216	48° 42'	109° 55'	2 x 6
1970	Liberty	1438.5	920 640	48° 44'	110° 51'	2 x 10
1969	Toole	1949.8	1 247 872	48° 53'	111° 46'	2 x 10

TABLE 3-26.- AVERAGE GROUND TRUTH PERCENTAGES IN MONTANA APU 23 FOR PHASE III BLIND SITES

State	Segment	CRD	APU	County	APU 23 average percent barley	APU 23 average precent spring wheat	APU 23 average percent winter wheat	APU 23 average percent oats	APU 23 average percent flax
Montana	1529	20	23	Blaine	1.1	.2	3.5	2.1	--
Montana	1531	20	23	Phillips	3.4	10.4	6.7	.9	--
Montana	1730	20	23	Chouteau	5.3	2.3	18.4	--	--
Montana	1734	20	23	Hill	2.8	.4	40.6	.2	--
Montana	1739	20	23	Teton	7.2	3.0	17.9	.4	--
Montana	1741	20	23	Toole	.1	.2	11.3	--	--
Montana	1742	50	23	Cascade	7.8	5.2	23.2	.1	--
Montana	1747	50	23	Judith Basin	9.1	--	15.3	.3	.1
Montana	1929	20	23	Blaine	10.3	29.5	1.5	1.2	--
Montana	1937	20	23	Pondera	24.9	1.5	24.4	.5	.2
Montana	1948	50	23	Fergus	4.7	--	11.9	--	1.2
Montana	APU 23 average percent	--	23	--	7.0	4.8	15.9	.5	.1

TABLE 3-27.- AVERAGE GROUND TRUTH GRAIN PERCENTAGES IN MONTANA APU 23 FOR TRANSITION-YEAR BLIND SITES

State	Segment	CRD	APU	County	APU 23 average percent barley	APU 23 average percent spring wheat	APU 23 average percent winter wheat	APU 23 average percent oats	APU 23 average percent flax
Montana	1731	20	23	Chouteau	NP	NP	NP	--	--
Montana	1938	--	23	Teton	NP	NP	NP	--	--
Montana	1948	50	23	Fergus	NP	NP	NP	--	--
Montana	APU 23	--	23	--	4.6	3.5	17	--	--

TABLE 3-28.- AREA PLANTED AS PERCENTAGE OF TOTAL CROPLAND IN LIBERTY COUNTY, MONTANA (1969)
[From ref. 6]

Crop	Percent
Wheat	27.98
Hay	2.28
Other small grains	14.8
Other crops	54.94

TABLE 3-29.- AREA PLANTED AS PERCENTAGE OF TOTAL CROPLAND IN HILL COUNTY, MONTANA (1969)
[From ref. 6]

Crop	Percent
Wheat	32.68
Hay	2.87
Other small grains	10.54
Other crops	53.91

TABLE 3-30.- AREA PLANTED AS PERCENTAGE OF TOTAL CROPLAND IN TOOLE COUNTY, MONTANA (1969)
[From ref. 6]

Crop	Percent
Wheat	23.18
Hay	2.14
Other small grains	23.17
Other crops	51.51

TABLE 3-31.- WHITMAN COUNTY, WASHINGTON (SECONDARY REGION), COMPARED TO NORTH CAUCASUS BARLEY AND WINTER WHEAT REGION

	Whitman County, Washington	North Caucasus
Climate	Dry, steppe, cold to mild winters, cool air in summers Summer thunderstorms Ordinarily, drought not a problem Average winter snowfall, 20 to 40 inches Reliable snow cover protects against winter kill Average annual temperatures: 9.1° C For growing season: +18.2° C Average annual precipitation: 533 mm Growing season precipitation: 66 mm	Semiarid Cold to mild winters, thin snow cover Snow retention required to prevent winter kill Warm summers with a mean relative humidity of 61% 15-35% chance of drought between May and July Slightly less precipitation in summer then occurs in winter Average mean minimum temperature: -5.6° C Average mean maximum temperature during growing season: +25.6° C Average annual precipitation: 508 mm Snow cover: 50-70 days Average January temperature: -4.4° C Average July temperature: 18° C [From ref. 6]
Agronomy	Major small grains present: Barley: 10.2% Wheat (all): 42.2% Corn: .1% Green peas: .2% (Percentages for Whitman Co., Wash., from ancillary summary) Other crops present: Lentils, oats, sorghum, sugar beets, potatoes Wheat grown on level land to steep slopes Little irrigation Average field size: 92 hectares Wheat rotated with summer fallow, or wheat followed by dry peas or lentils All small grains are harvested by direct combining Lentils are windrowed	Major small grains present: Barley: 14.8% Winter wheat: 32.9% Spring wheat: 0.2% Oats: 1.1% Rye: 1.0% Other grain: 2.5% (Percentage of sown crops in 1977) Other crops present: Corn, sugar beets, sunflowers, millet Large scale collective farms Strip cropping and some irrigation Postharvest scuffling subsurface plowing to retain winter and destroy weeds Snow retention
Geomorphology	Rolling terrain Elevations of 600 to 3500 feet	Plains and foothills Elevations of 500 to 2500 feet
Geology	Palouse hill region	Stavropol plateau composed of uplifted tertiary strata: clays, sandstones, shales, sediments, and outcrops of igneous rocks
Soils	Mollisol (nearly black) Alfisol (brownish) Best soil and moisture conditions for wheat in northwest	Black (west) and brown (east) soil
Native vegetation	Wheat, fescue, blue, and cheat grasses, and small shrubs	Virgin steppe (mostly plowed for agriculture)

TABLE 3-32.- AVAILABLE ACQUISITIONS WITH GROUND TRUTH FOR WHITMAN COUNTY, WASHINGTON, INTENSIVE TEST SITES

Segment number	LACIE Phase I			LACIE Phase II			LACIE Phase III		
	Acquisition data	Sun angle, degree	Satellite	Acquisition data	Sun angle, degree	Satellite	Acquisition data	Sun angle, degree	Satellite
1972	5218	51	2	6142	54	2			
1973	5183	56	2	5308	23	2	6285	30	2
1973				6124	50	2	6286	30	2
1973				6141	54	2	7045	22	2
1973				6142	54	2	7046	22	2
1973				6178	56	2	7100	42	2
1973				6195	54	2	7118	47	2
1973				6196	54	2	7208	50	2
1973				6231	47	2			
1973				6268	36	2			
1974	5182	56	2	5308	23	2			
1974				6124	50	2			
1974				6142	54	2			
1974				6195	54	2			
1974				6231	47	2			
1974				6268	36	2			

TABLE 3-33.- AVAILABLE ACQUISITIONS FOR WHITMAN COUNTY, WASHINGTON, INTENSIVE TEST SITES

Segment	1972	1973	1974
Phase I 1974-1975 Acquisitions	4268 4269 5111 5218 5219	4269 4286 4287 5110 5111 5129 5201	4268 4269 4286 4287 5182 5183 5218 5219
Phase II 1975-1976 Acquisitions	5308 6142 6231	5308 6016 6069 6087 6124 6141 6142 6178 6195 6196 6231	5308 6124 6142 6195 6196 6231 6268
Phase III 1976-1977 Acquisitions		6285 6286 7045 7046 7100 7118 7208	6286

TABLE 3-34.- CROPPING CALENDAR FOR THE PRINCIPAL CROPS GROWN IN THE SOUTHEASTERN AREA OF THE STATE OF WASHINGTON

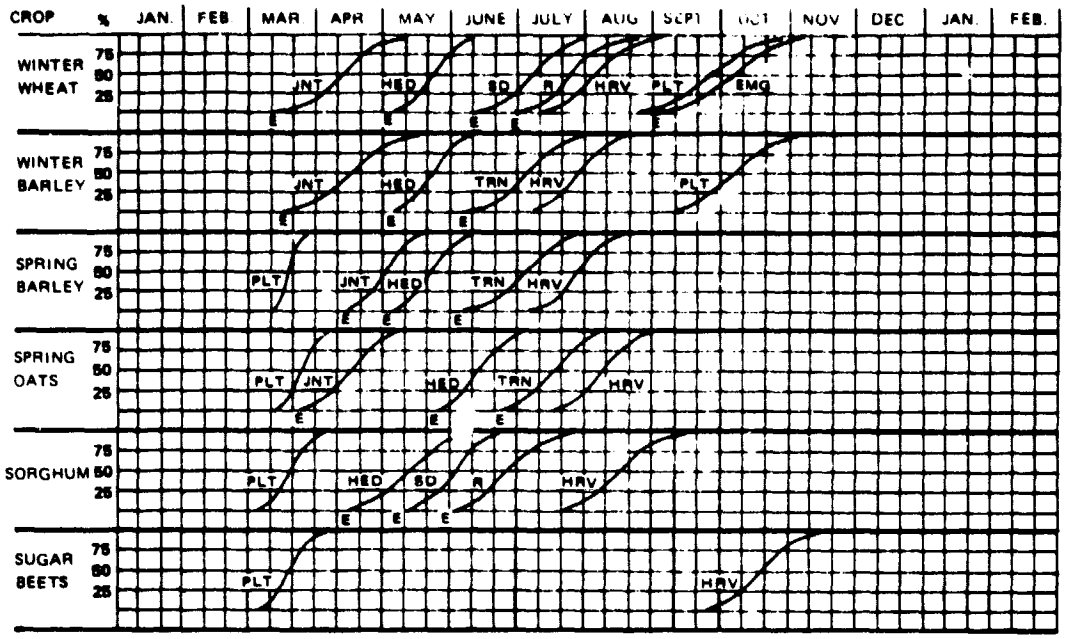
Crop	Seedbed preparation			Full coverage			Heading-flowering			Postharvest operations		
	Start	Midpoint	End	Start	Midpoint	End	Start	Midpoint	End	Start	Midpoint	End
Barley	Aug. 30	Mar. 1	Mar. 15	Mar. 25	Apr. 30	May 15	June 5	June 25	July 10	Sept. 20	Oct. 15	Nov. 15
Oats	Mar. 1	Mar. 20	Apr. 1	Apr. 25	May 10	May 25	June 20	July 5	July 20	Sept. 5	Oct. 15	Nov. 1
Spring wheat	Feb. 25	Mar. 5	Mar. 15	Apr. 20	May 5	May 20	June 10	June 25	July 10	Sept. 20	Oct. 15	Nov. 15
Winter wheat	Sept. 1	Sept. 20	Oct. 10	Nov. 1	Apr. 20	May 15	June 5	June 25	July 10	Sept. 20	Oct. 15	Nov. 15

TABLE 3-35.- USUAL PLANTING AND HARVESTING DATES BY CROPS FOR WASHINGTON

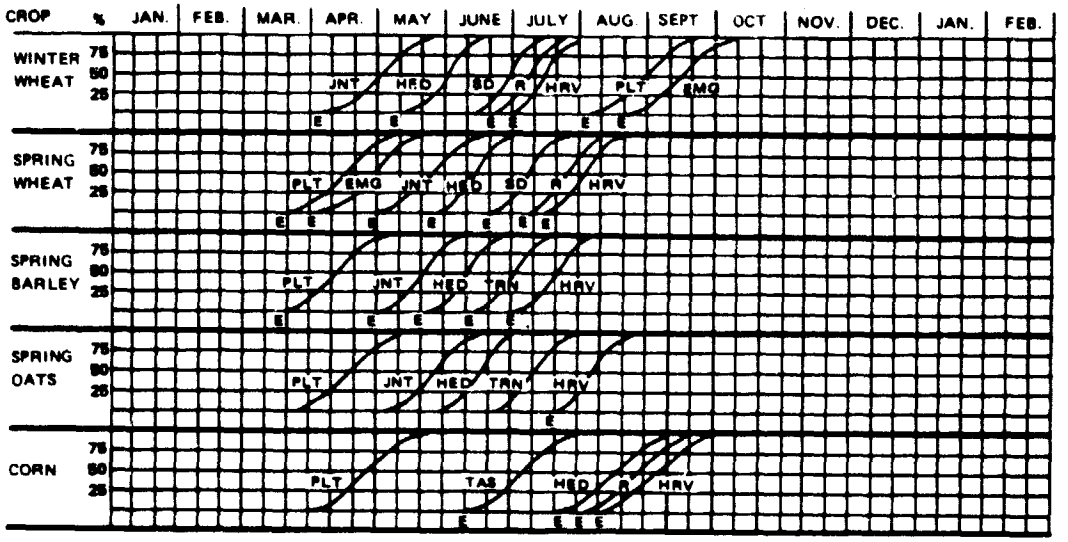
[From ref. 6]

Crop	Usual planting dates	Usual harvesting dates		
		Begin	Most active	End
Barley, fall sown	Sept. 1-Nov. 1	July 1	July 15-Aug. 10	Aug. 20
Beans, dry	May 1-June 10	Aug. 20	Sept. 5-Sept. 30	Nov. 1
Corn:				
Grain	May 1-June 5	Oct. 15	Oct. 25-Nov. 20	Dec. 15
Silage	May 1-June 5	Sept. 1	Sept. 5-Oct. 5	Oct. 15
Forage	May 1-June 5	Oct. 1	Oct. 5-Oct. 25	Nov. 1
Hay:				
Alfalfa		June 1		Sept. 25
Clo-tim		May 25		Aug. 15
Wild		June 1		Aug. 15
Lentils:	Apr. 10-May 10	July 15	July 25-Aug. 25	Sept. 1
Peas, dry	Apr. 5-May 1	July 15	July 25-Aug. 25	Sept. 1
Rye	Aug. 10-Nov. 1	July 5	July 20-Aug. 15	Sept. 1
Sugar beets	Mar. 1-Apr. 10	Sept. 20	Oct. 10-Nov. 10	Nov. 20
Seed crops:				
Alfalfa		Aug. 25	Sept. 10-Oct. 15	Oct. 30
Red clover		Aug. 20	Sept. 5-Oct. 10	Oct. 15
Merion Kentucky bluegrass		July 10	July 25-Aug. 15	Sept. 1
Red fescue		July 10	July 25-Aug. 15	Sept. 1
Bentgrass		Aug. 5	Aug. 20-Sept. 5	Sept. 25

Whitman County, Washington



North Caucasus Region



LEGEND

E	Under stage name, indicates rough estimate of date
EMG	Emergence
HED	Heading
HRV	Harvest
JNT	Jointing
PLT	Planting
R	Ripe
SD	Soft dough
TRN	Turning
TAS	Tasseling

Figure 3-7.- Nominal crop calendars for Whitman County, Washington, and the North Caucasus RSFSR Barley and Winter Wheat Region.

3.3.3 BANNOCK, FRANKLIN, AND ONEIDA COUNTIES, IDAHO (TERTIARY REGION)

Bannock, Franklin, and Oneida Counties, Idaho, were chosen as a tertiary similarity region for the North Caucasus Region because of the high proportion of barley and wheat grown in the region, the comparable climate, and the availability of ground truth (table 3-36). Both regions also experience a continental climate, including some maritime influence with cold winters and warm summers. Winter wheat is the major crop in both regions, with barley being the second largest crop.

The North Caucasus Region usually has more annual precipitation, but during the growing season the average precipitation for the two regions may be considered equivalent. In southwestern Idaho, contour farming with strip cropping, block-shaped fields, terracing, and some irrigation are practiced. In the North Caucasus Region, the norm is large-scale collective farms with huge fields, and limited strip cropping and irrigation.

A disadvantage of these southeastern Idaho counties as a similarity region is that there are no ground truth blind sites allocated. The three allocated intensive test sites in southeastern Idaho had ground truth data collected for LACIE Phases I and II (tables 3-37 and 3-38). These three sites have been subsequently dropped, and ground truth has not been collected since that time.

The nominal growth stages for barley and winter wheat are similar (fig. 3-8), although some variations are apparent. Note that winter wheat has a shorter cycle between heading and soft dough in the North Caucasus than does the wheat in the Idaho counties.

Elevations, mean temperatures, and precipitation data for the three counties are provided in table 3-39. Tables 3-40, 3-41, 3-42, 3-43, and 3-44 provide crop area statistics and the number of farms and average field size for Bannock, Franklin, and Oneida Counties. Tables 3-45 and 3-46 provide more detailed growth stage data for small grains in Idaho.

TABLE 3-36.- BANNOCK, FRANKLIN, AND ONEIDA COUNTIES, IDAHO (TERTIARY REGION), COMPARED TO NORTH CAUCASUS BARLEY AND WINTER WHEAT REGION

	Oneida, Franklin, and Bannock Counties, Idaho	North Caucasus
Climate	Continental climate with some maritime influence, particularly in the winter Average January minimum temperature: -10.5° C Average January maximum temperature: +0.1° C Average July minimum temperature: +11.7° C Average July maximum temperature: +31.7° C Average growing season temperature: +20.2° C Average annual precipitation: 357 mm Average July precipitation: 18.8 mm	Semiarid Cold to mild winters with thin snow cover Snow retention required to prevent winter kill Warm summers with a mean relative humidity of 61% 15-35% chance of drought between May and July Slightly less predipitation in summer than ocurrs in winter Average mean minimum temperature: -5.6° C Average mean maximum temperature during growing season: +25.6° C Average annual precipitation: 508.0 mm Snow cover: 50-70 days Average January temperature: -4.4° C Average July temperatue: 18° C
Agronomy	Major small grains present: Barley: 22.2% Wheat: 57.1% Potato: .4% Hay: 19.2% (Percent of total cropland in Oneida Co., 1971, ref. 6) Other crops present: corn, grain, sorghum Dry and irrigated farms 20% of winter wheat irrigated 66% of spring wheat irrigated Contour farming, some strip cropping, terracing, wheat planted block dimensions, crop rotation is 2 years wheat, 2 years sugar beets, 2 years potatoes Average field size: 21.5 hectares Dryland wheat up to 200 hectares Spring wheat continuously cropped, winter wheat has fallow period Land tilled by moldboard and disk plow	Major small grains present: Barley: 14.8% Winter wheat: 32.9% Spring wheat: 0.2% Oats: 1.1% Rye: 1.0% Other grain: 2.5% (Percentage of sown crops in 1977, ref. 6) Other crops present: corn, sugar beets, sunflowers, millet Large-scale collective farms Strip cropping and some irrigation Postharvest scuffling, and subsurface plowing to retain water and destroy weeds Snow retention
Geomorphology	Broad valleys surrounded by mountains in Columbia River basin Elevation approximately 4500 feet	Plains and foothills Elevations from 500 to 2500 feet
Geology	Old lava flows Alluvial fans Mountain barriers	Stavropol plateau composed of uplifted tertiary strata: clays, sands, shales, sediments, and outcrops of igneous rocks
Soils	Brown colors Mollisol, xeroll, argixeroll, haploxeroll	Black (west) and brown (east) soil
Native vegetation	Steppe sagebrush	Virgin steppe (largely plowed for agriculture)

TABLE 3-37.- AVAILABLE ACQUISITIONS WITH GROUND TRUTH FOR BANNOCK, FRANKLIN, AND ONEIDA COUNTIES, IDAHO, INTENSIVE TEST SITES

County	Segment number	LACIE Phase I			LACIE Phase II			LACIE Phase III		
		Acquisition data	Sun angle, degree	Satellite	Acquisition data	Sun angle, degree	Satellite	Acquisition data	Sun angle, degree	Satellite
Oneida County	1975	5159	59	2	6136	56	2	No available acquisitions		
	1975	5178	59	2	6137	56	2			
	1975	5195	57	2	6155	58	2			
	1975	5232	50	2	6172	58	2			
	1975				6173	58	2			
	1975				6190	56	2			
	1975				6191	56	2			
	1975				6208	54	2			
	1975				6209	54	2			
	1975				6226	50	2			
	1975				6227	50	2			
	1975				6244	46	2			
	1975				6245	46	2			
Franklin County	1976	4299	30	1	5304	29	2			
	1976	4317	25	1	6136	56	2			
	1976	4335	21	1	6190	56	2			
	1976	5159	59	2	6208	54	2			
	1976	5177	59	2	6226	50	2			
	1976	5195	57	2						
	1976	5213	54	2						
	1976	5214	54	2						
Bannock County	1977	4299	29	1	6101	46				
	1977	4300	29	1	6137	55				
	1977	4317	24	1	6227	50				
	1977	4335	20	1	6245	45				
	1977	4336	20	1	6263	40				
	1977	5196	56	2						
	1977	5214	53	2						

TABLE 3-38.- AVAILABLE ACQUISITIONS FOR BANNOCK, FRANKLIN, AND ONEIDA COUNTIES, IDAHO, INTENSIVE TEST SITES

Segment	1975	1976	1977
Phase I 1974-1975 Acquisitions	5159 5178 5195 5232	4299 4317 4335 5159 5177 5195 5213 5214 5232	4299 4300 4317 4335 4336 5196 5214
Phase II 1975-1976 Acquisitions	6136 6137 6155 6172 6173 6190 6191 6208 6209 6226 6227 6244 6245 6263	5304 6136 6190 6208 6226	6101 6137 6227 6245 6263
Phase III 1976-1977 Acquisitions	6281 6316 7112 7113 7166 7185 7203 7221	6280 6298 6316 6334 6352 7094 7112 7148 7166 7184 7202	6280 6281 6298 6316 6317 6334 6353 7094 7112 7167 7203 7221

TABLE 3-39.- ELEVATIONS, MEAN TEMPERATURES, GROWING SEASONS, AND ANNUAL PRECIPITATION IN BANNOCK, FRANKLIN, AND ONEIDA COUNTIES, IDAHO

[FROM REF. 6]

Location	Elevation, ft.	January		July		Length of growing season, days	Precipitation		
		Min.°	Max.°	Min.°	Max.°		Annual	Jan.	July
Pocatello, Bannock	4454	14.1°	31.9°	54.8°	88.9°	142	10.85	1.21	.51
Preston, Franklin	4815	11.2°	32.5°	50.5°	90.2°	118	15.49	1.50	.65
Malad City, Oneida	4420	13.1°	32.2°	53.1°	89.0°	128	13.97	1.51	.74

TABLE 3-40.- AREA PLANTED AS PERCENTAGE OF TOTAL CROPLAND IN BANNOCK COUNTY, IDAHO, IN 1971

[From ref. 6]

Crop	Percent
Wheat	47.8
Barley	23.7
Potato	4.0
Silage corn	0.3
Silage sorghum	0.01
Hay	20.2
Fruits and vegetables	0.12
Others	3.9

TABLE 3-41.- AREA PLANTED AS PERCENTAGE OF TOTAL CROPLAND IN FRANKLIN COUNTY, IDAHO, IN 1971

[From ref. 6]

Crop	Percent
Wheat	29.6
Barley	29.9
Potato	0.9
Corn grain	0.2
Silage	3.4
Hay	31.2
Fruits and vegetables	2.2
Others	2.6

TABLE 3-42.- AREA PLANTED AS PERCENTAGE OF TOTAL CROPLAND IN ONEIDA COUNTY, IDAHO, IN 1971

Crop	Percent
Wheat	57.1
Barley	22.2
Potato	0.4
Corn grain	0.02
Silage	0.02
Grain sorghum	0.04
Hay	19.2
Others	1.1

TABLE 3-43.- TOTAL NUMBER OF FARMS AND ACREAGE HARVESTED FOR THE INTENSIVE TEST SITES IN IDAHO (COUNTY DATA) [From ref. 6]

County	No. of farms	Total acreage
Bannock	457	114,637
Franklin	650	86,463
Oneida	363	106,392

TABLE 3-44.- NUMBER OF FIELDS, AVERAGE SIZES, AND RANGES IN FIELD SIZE WITHIN THE IDAHO TEST SITES

County	Test site size, miles	No. of fields	Avg. field size, acres	Range in field size, acres
Bannock	3 x 3	80-90	55	5-130
Franklin	3 x 3	295-315	15	2.5-40
Oneida	3 x 3	60-70	90	20-160

TABLE 3-45.- CROPPING CALENDARS FOR THE PRINCIPAL CROPS GROWN IN THE EASTERN CROP REPORTING DISTRICT OF IDAHO

[From ref. 6]

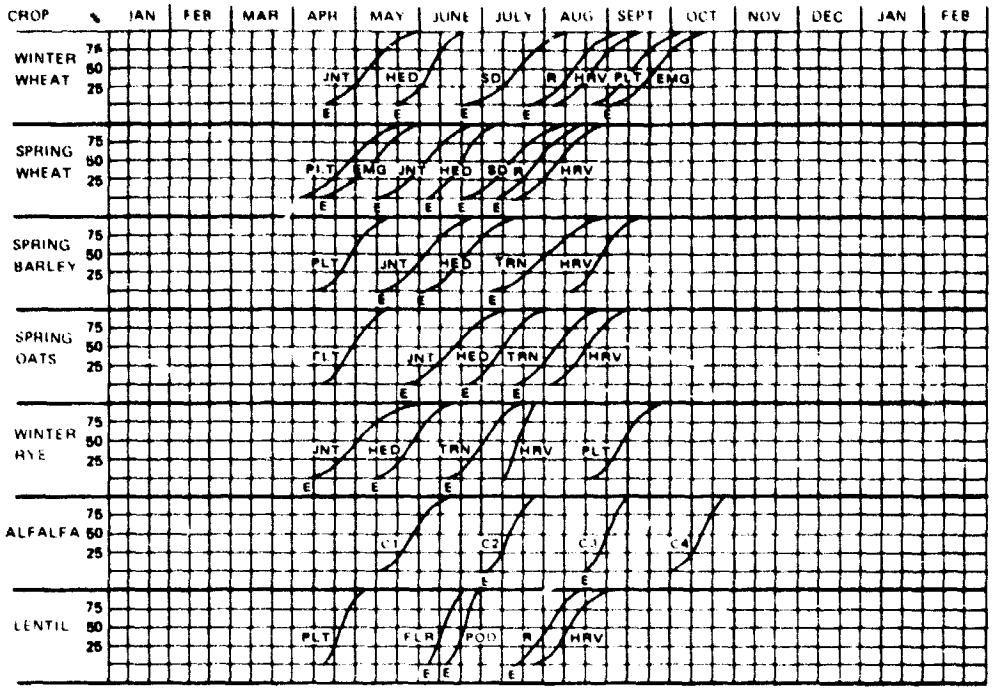
Crop	Seedbed preparation			Full cover			Heading-flowering			Postharvest		
	Start	Midpoint	End	Start	Midpoint	End	Start	Midpoint	End	Start	Midpoint	End
Winter wheat	Aug. 20	Sept. 15	Oct. 10	Apr. 15	Apr. 20	May 25	May 15	June 1	June 15	Sept. 15	Sept. 27	Oct. 10
Spring wheat	Apr. 5	Apr. 25	May 15	May 15	June 5	June 30	June 5	June 20	July 5	Sept. 15	Sept. 23	Oct. 10
Rye	Aug. 20	Sept. 15	Oct. 10	Apr. 15	Apr. 20	May 25	May 15	June 1	June 15	Sept. 15	Sept. 27	Oct. 10
Oats	Apr. 5	Apr. 25	May 20	May 15	June 5	June 30	June 5	June 25	July 20	Sept. 15	Sept. 27	Oct. 10
Barley	Apr. 5	Apr. 28	May 20	May 15	June 5	June 30	June 5	June 20	July 5	Sept. 15	Sept. 27	Oct. 10

TABLE 3-46.- USUAL PLANTING AND HARVESTING DATES BY CROPS IN IDAHO

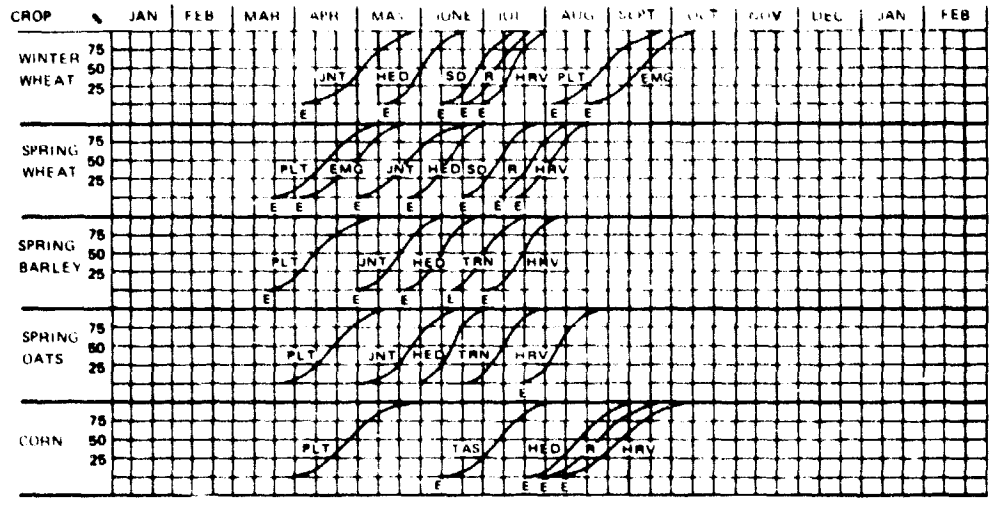
[From ref. 6]

Crop	Usual planting dates	Usual harvesting dates		
		Begin	Most active	End
Beans, dry	May 15-June 10	Aug. 20	Aug. 25-Sept. 5	Sept. 15
Corn:				
Grain	May 1-May 25	Oct. 10	Oct. 25-Nov. 15	Dec. 10
Silage	May 1-June 5	Sept. 1	Sept. 10-Sept. 30	Oct. 10
Forage	May 1-June 5	Oct. 1	Oct. 10-Oct. 30	Nov. 5
Hay:				
Alfalfa		June 5		Oct. 15
Col-tim		June 20		Sept. 1
Wild		July 10		Aug. 20
Grain		July 25		Aug. 10
Other		June 10		Aug. 15
Lentils	Apr. 15-May 5	Aug. 5	Aug. 15-Aug. 25	Sept. 5
Sugar beets	Mar. 20-May 10	Oct. 1	Oct. 10-Nov. 10	Nov. 15
Seed crops:				
Alfalfa		Aug. 25	Sept. 5-Sept. 25	Oct. 20
Red clover		Sept. 10	Sept. 20-Oct. 10	Oct. 20
White clover		Aug. 10	Aug. 20-Sept. 10	Sept. 20
Merion Kentucky Bluegrass		July 10	July 15-Aug. 1	Aug. 10
Austrain winter peas		Aug. 1	Aug. 15-Sept. 5	Sept. 15

Bannock, Franklin, and Oneida Counties, Idaho



North Caucasus Region



LEGEND

E	Emergence
EMG	Emergence
HED	Heading
HRV	Harvest
JNT	Jointing
PLT	Planting
R	Ripe
SD	Soft dough
TRN	Turning
TAS	Tasseling

Figure 3-8.- Nominal crop calendars for Bannock, Franklin, and Oneida Counties, Idaho, and the North Caucasus RSFSR Barley and Winter Wheat Region.

4. REFERENCES

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APPENDIX A

FOREIGN SIMILARITY REGION SELECTION CRITERIA

APPENDIX A

FOREIGN SIMILARITY REGIONS SELECTION CRITERIA

A.1 INTRODUCTION/BACKGROUND

A.1.1 FOREIGN INDICATOR REGION

The ITD project requires the identification of foreign areas of interest for the development of area estimation technology. Detailed studies of the foreign countries are not within the scope of this project. Therefore, smaller sub-country indicator regions for which studies will be made have been determined. These indicator regions are chosen to be typical of the crop of interest in the whole country. It is anticipated that the labeling and classification accuracies obtained in the indicator regions will be representative of those that would be obtained at the national level.

A.1.2 FOREIGN SIMILARITY REGION

It is difficult to develop and test analysis techniques in foreign countries, because ground truth is not available. Therefore, technology needs to be developed for similar regions in the United States and Canada where ground truth is available that can then be applied in the corresponding foreign region. These foreign similarity regions will be chosen to have the same agronomic and climatological characteristics as the corresponding foreign indicator region. The criteria for their selection are discussed further in section 2.

One of the primary uses of the United States and Canada Foreign Similarity Regions will be to aid in developing simulations and error models that can be extended to foreign indicator regions. Therefore, the selection criteria for foreign similarity regions must be in regard to variables related to labeling and classification performance. Some of the factors which affect estimation accuracy are dynamic and will change dramatically from one year to another. Examples are acquisition history, crop calendar deviations from the expected, and moisture stress. However, other factors are static and only change very slowly with time. These are related to geography and can be used for foreign similarity region selection, whereas the dynamic variables cannot.

For the preparation of the selection criteria established in this letter, the following considerations have to be kept in mind.

1. Data must be available on the variable in both the foreign similarity regions and in the indicator regions.
2. The variable used must not change significantly from year to year.
3. Ground truth segments must be available in the foreign similarity regions.
4. The variables selected must be expected to influence the labeling and classification performance.

A.2 APPROACH TO FOREIGN SIMILARITY REGION SELECTION

A.2.1 STATIC VARIABLES AFFECTING FOREIGN SIMILARITY REGION SELECTIONS

Two general conditions must be considered when selecting foreign similarity regions. The first condition is climate, and the second condition is agronomy. The climate and agronomic conditions of a region are considered static because the range of their variations can be determined within certain limits.

Table A-1 depicts the process of selecting foreign similarity regions. Each step is discussed further in the following sections. For a particular foreign country, the similarity obtained will be dependent on the considerations mentioned in section 1; stratification for all four levels may not always be obtainable.

A.2.2 CLIMATIC SIMILARITY

Since 1900, the general climatic regions of the world have been extensively studied and documented. Using existing climatic classification schemes, scientists have compared different regions of the world and identified regions that are climatically similar.

A.2.3 FIRST-LEVEL STRATIFICATION: CLIMATE

The first step in selecting foreign similarity regions is to identify areas in the United States or Canada that are climatically similar to the foreign

TABLE A-1.- FSR SELECTION FLOW

I. STATIC VARIABLES	
A. Climatic	
1. First-level stratification:	Similar climate
B. Agronomic	
1. Second-level stratification:	Similar crops of interest, confusion crops, and distribution
2. Third-level stratification:	Similar growth cycles
3. Fourth-level stratification:	Similar field sizes and shapes

indicator regions, using published climatic classification systems. The Modified Koppen and the C. W. Thornthwaite Climatic Classification Systems will be used for this first-level stratification (refs. 1 and 2).

A.2.4 AGRONOMIC SIMILARITY

Certain agronomic conditions must be similar between the selected United States and Canadian regions and the foreign indicator region.

Some of these conditions have been shown to have a small variance from year to year and are considered static. Four static conditions that reflect the general agronomic situation within a region are: (1) the crop types present, (2) the amount and type of confusion (crops) with the crops of interest, (3) the crop growth cycles, and (4) the field sizes and shapes recorded by Landsat.

A.2.5 SECOND-LEVEL STRATIFICATION: CROPS OF INTEREST AND CONFUSION CROPS

Once United States and Canadian climatic regions similar to the foreign indicator regions have been identified (first-level stratification), a second-level stratification will be performed based on the types and proportions of crops present. The significant crop types that are grown in the foreign

indicator region should also be present in the United States or Canadian similarity region. Attention will be given to the presence of crops that will confuse with the crops of interest (such as winter wheat and winter rye). Ideally, both the United States and Canada similarity region and the foreign indicator region will have essentially the same crops grown in approximately the same proportions.

The distribution of the crops must also be examined for agreement. The indicator region may have the crops evenly distributed throughout the agricultural area, whereas the corresponding region in the United States or Canada may have the predominant crops growing separately in different zones. Therefore, the similarity region selected should, in addition to having equivalent crop types and proportions, have the crops distributed in the same manner as the foreign indicator region.

A.2.6 THIRD-LEVEL STRATIFICATION: GROWTH CYCLES

The third-level stratification will be based on the crop growth cycles. This will be accomplished by comparing the nominal crop calendars of the two regions. The length of the Robertson Growth Stages for the major crops should be (approximately) the same in both the similarity region and the foreign indicator region.

A.2.7 FOURTH-LEVEL STRATIFICATION: FIELD SIZES AND SHAPES

The size and shape of agricultural fields can affect area estimation accuracies. Small fields and strip cropping increase the number of boundary pixels as recorded by Landsat, which contributes to errors in labeling and classification.

The fourth-level stratification will be performed by comparing Landsat data over the respective regions for similar field patterns and size. A region of small strip fields would not be considered similar to one where large mechanized farming is practiced.

A.3 SUMMARY OF REQUIREMENTS

The following materials will be required in support of the foreign similarity region selections:

- Modified Koppen and C. W. Thornthwaite worldwide climatic schemes.
- United States and Canada ground truth for blind site segments.
- Foreign indicator region and United States and Canada segment packets (containing imagery, ancillary summaries, maps, and nominal crop calendars).
- Foreign indicator region and United States and Canada full-frame Landsat imagery.
- Multiple-year area, yield, and production statistics (at region, zone, and strata levels) for the foreign indicator regions and AgRISTARS regions within the United States and Canada.
- Universal strata discriptors for the foreign indicator regions (if available) and for the United States and Canada AgRISTARS regions.

A.4 REFERENCES

1. Thornthwaite, C. W.: An Approach Toward a Rational Classification of Climate. Geographical Review 38: 55-94, 1948.

2. Koppen, W.: The Shorter Oxford Economic Atlas of the World. Oxford University Press, third edition, 1968.

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